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ABSTRACT

This study is based on the premises that information technologies (IT) are essential to African development and that education systems are responsible for developing a countries' human capacity to maximize those technologies. The study examines the ability of education systems in Mali and Ghana to develop the capacity to harness the potential of information technologies for African-empowered development. The condition of education and telecommunications in each country is examined in light of five conditions that indicate the existing and potential resources and intent of the systems: awareness, access, applicability, African adaptability, and importance of advocates. Evidence of these indicators is synthesized and analyzed to draw conclusions about why Malian and Ghanaian education systems can or cannot build the stipulated capacity under current conditions. A model is then recommended for how to proceed, based on the information and analysis. Areas for future research are suggested. Includes 26 notes. Contains an information sheet on acronyms, abbreviations, and definitions. (Contains a figure, 8 tables, and a 111-item bibliography.) (Author/BT)

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August 2000

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Abstract

This study is based on the premises that information technologies (IT) are essential to African development and that education systems are responsible for developing countries' human capacity to maximize those technologies. It examines the ability of education systems in Mali and Ghana to develop the capacity to harness the potential of information technologies for African-empowered development. The condition of education and telecommunications in each country is examined in light of five conditions that indicate the existing and potential resources and intent of the systems: awareness, access, applicability, African adaptability, and importance of advocates. Evidence of these indicators is synthesized and analyzed to draw conclusions about why Malian and Ghanaian education systems can or cannot build the stipulated capacity under current conditions. A model is then recommended for how to proceed, based on the information and analysis provided.

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Acronyms, Abbreviations, and Definitions

ADP: (Ghana). Accelerated Development Plan. The Ministry of Communications' plan for the rapid development of the telecommunications infrastructure and industry.

Africa: In this paper, Africa refers to sub-Saharan Africa. Also, when making generalizations about systems and conditions, some likely do not apply to South Africa.

APE: (Mali). Association Parents d'Élèves. Students' parents association.

CAP: (Mali). Centre d'Animation Pédagogique. An extension of the Ministry of Education, centers created at the district level to support the teaching mission of community schools and help provide for their management (Charlick et al., 1998; PRODEC Grandes Orientations, 1998).

FCUBE: (Ghana). A ten-year program (1996–2005) designed to provide every child with a good quality education, improve the teaching process and learning outcomes, strengthen management of the basic education system, and improve access to education—especially for girls and disadvantaged segments of population.

GES: (Ghana). Ghana Education Service. The branch of the state education systems that implements 80 percent of the functions at the pre-university level.

GOG: Government of Ghana.

GOM: Government of Mali

ICT: Information and Communication Technologies—see Information Technologies.

ISP: Internet Service Provider.

IT: Information Technologies. Like Byron and Gagliardi's definition of "new technologies," IT "principally include[s] the developing technologies of telecommunications, computing and microelectronics and their convergence which has created a range of new possibilities for information collection, storage, manipulation, transmission and presentation" (Byron & Gagliardi, 1998).

MOE: Ministry of Education.

NACVET: (Ghana). The National Council of Technical and Vocational Training. The organization responsible for building the technical skills of Ghanaians.

NEF: (Mali). Nouvelles Écoles Fondamentales (New Primary Schools). Community-run schools' more active and non-formal approach was taken to pedagogy and an emphasis was given to using maternal languages alongside French.

NFLP: (Ghana). National Functional Literacy Programme. A program focused on identifying target populations to help them read, write, and compute in one of the 15 local languages.

NGO: Nongovernmental Organization. In this paper, refers to local (Malian or Ghanaian) organizations that are not created or managed by the government.

PIE: (Ghana). Partners for Internet in Education. See http://members.xoom.com/pieghana.

PRODEC: (Mali). Programme Décennal de Développement de l'Éducation. Mali's ten-year education plan, begun in 1998.

SPAM: (Ghana). School Performance Appraisal Meeting. The mechanism for the MOE to keep communities informed of their schools' performance and to encourage them to participate in maintaining a high-quality education (Essah-Hienno, 2000).

USAID: United States Agency for International Development.

Vision 2020: (Ghana). This plan is designed to bring Ghana to middle-income status by the year 2020 by reducing poverty, increasing employment opportunities and Ghanaians' average incomes, and reducing inequities to improve the general welfare and material being of all Ghanaians.

WorLD: The World Bank's World Links for Development Program. See http://www.worldbank.org/worldlinks.

A Note About the Data

There are a number of sources of data in this study, but the bulk of the data is from those listed below. These descriptions explain and qualify the data:

World Development Indicators

Teacher-Pupil Ratio: For Mali. The number of pupils enrolled in primary school divided by number of primary school teachers-regardless of their assignment. (From UNESCO's Division of Statistics in cooperation with national commissions and national statistical services. Using UNESCO statistical yearbook 1998.)

Cost of a Local Call: For Mali. (From the ITU.)

Cost of a Three-Minute Call to the U.S.: For Mali. The peak rate call. (From the ITU.)

International Telecommunications Union

Population: Mid-year estimates from the United Nations.

GDP: From the IMF or the World Bank.

Main telephone lines: Lines that connect customers' equipment to the national operator; in most countries this includes public pay phones.

Wait list: Number of applications received for telephone service.

Waiting time: The time if the number of applicants on the waiting list is divided by the average number of main lines connected per year over the last three years.

Number of Public Phones: Includes both coin and card, some include public phones installed in private places; there is no distinction on whether they are operational.

Cost of a Three-minute local call: Assumes private line; the cost for a three-minute call, not the average for three minutes on the telephone. Taxes are included in this price.

UNESCO Statistical Yearbook

For this study, all of the data used is from 1994/5 for consistency. Much of the data for Ghana is missing.

Intake: Number of new entrants into the first grade of primary education, regardless of age, expressed as a percentage of the population of official admission age.

Repeaters: Total pupils enrolled in the same grade as the previous year, expressed as a percentage of the total enrollment in primary education.

An Introduction: Africa, IT, and Education

Five years ago, only four of the 54 African countries had access to the Internet in their capital cities through their own gateways[1] and were able to provide Internet service to individual subscribers. Today, all but Eritrea manage their own access and many provide access to subscribers located outside of the capital (Jensen, 2000). However, as public demand for the Internet is also growing quickly the telecommunications infrastructure in Africa has not been able to expand enough to meet the need. Many customers wait for more than one year to have a phone line installed in their home or business. And, though the potential of new information technologies (IT) is getting much attention from leaders, governments have done little to actively promote the Internet's use for national development.

Mali and Ghana are among the poorest countries in the world, ranking 166th and 133rd, respectively (out of 174 countries), according to UNDP's Human Development Indicators. So though they might seem the least likely to integrate IT into their education systems because of poverty, in fact, both countries have significant beginnings in place. Because of the potential that IT holds for changing and improving education, these may be the places where IT will have the most impact.

National policies designed to harness the use of information technologies are in their formative stages in Mali and Ghana, and, to date, there are none in place addressing their applicability to education and thus developing the human capacity of the continent. This arena is different from most education reforms in that it is an intersection of two sectors—education and technology. The players and processes are not the ones usually found participating in education reform. Mobilizing the necessary resources and expertise requires communication and coordination among people from government

[1] Gateway: a telecommunications center that is linked with other similar centers internationally and/or domestically providing communications for distribution. With regard to Internet access in Africa, gateways are found at the telecommunications companies and sometimes at private sector Internet Service Providers and powerful international private sector companies (i.e., oil conglomerates, gold mines, etc.), depending upon the laws of each country.

institutions, nongovernmental organizations (NGOs), businesses and international organizations, and technical experts (Means et al., 1993). An element of creativity and innovation is brought into the process by virtue of involving new technologies and having different kinds of organizations working together towards a new kind of goal. Though Malian and Ghanaian education systems encourage participation from a variety of stakeholders, policy-making and implementation have retained their centrally-controlled processes. This rigidity is symptomatic of the inherited colonial systems and suggests that these systems have not evolved to promote innovative African development. This implies an inherent mismatch between the existing systems and those ideal for promoting the integration of information technologies into education systems.

In spite of the poor state of telecommunications infrastructure and the mal-developed education system, there are a number of pilot programs that have taken hold and inspired policy-makers to begin discussing and planning for policies for IT use in schools within Mali and Ghana (Respondent Mali#1). Because of this groundwork, these countries are ideal environments to examine the first steps of IT use in education and the feasibility for systemic proliferation of IT. Mali and Ghana provide similar but contrasting circumstances that allow this study to focus on the West African context, while looking at the variations between the countries due in part to their respective Francophone and Anglophone colonial heritage.

This study adopts the view that information technologies will play an important role in African development and that these tools require national strategies to be properly leveraged for African benefit. Though the education systems in Mali and Ghana may intend to develop their countries' human capacity, they are not capable at this time to harness the potential of IT use. This study lays out the conditions and their indicators, asserting that both the resources and the intentions of the education system need to be included to determine the ability of that system to support innovation to maximize IT use. This approach includes a range of factors that highlight the strengths and weaknesses of the systems in both Mali and Ghana, which are then analyzed to determine which factors are the most critical to integrating IT into education and what is the best way to proceed.

The Problem, the Question, and the Argument: What It Takes to Harness the Potential of IT

Harnessing the potential of information technologies entails more than simply proliferating their use. It means encouraging people to be innovative in applying and tailoring IT to their needs.

> ...indigenous implementation capacity is currently the most important constraint on Africa's ability to address challenges of globalization and their own social and economic development. This implies that African populations must be equipped with skills which are necessary, not only to access information via the Internet, but to learn from information and to apply knowledge innovatively (Fouché, 1998, p. 147).

Measuring what is necessary to harness the potential of IT on a systemic level includes understanding the capacity of the system to provide access to and training for IT, as well as the ability of the system to encourage—or at least enable—people to experiment and innovate to make these technologies respond to their needs. On a country level, indicators for harnessing IT include:

- the level of awareness among leaders and advocates of the potential of IT and what is needed to harness it,
- the state of education and telecommunications,
- the nature of the education and telecommunications systems and their current policies, and
- the ability of those systems to adapt models to African needs.

In the case studies that follow, an inventory of these factors identify the strengths within and between the systems under study, and the ensuing analysis answers the question: Why are Malian and Ghanaian education systems able or not able to harness the potential of IT use?

To explain why this may be the case, this study explores two overarching factors: the resources needed to implement IT activities and the intentions of the education systems. There are critical resources that contribute to an enabling education environment for IT use, including but not limited to infrastructure and materials. Intentions to integrate IT can be identified by considering the support given by decision-makers and whether the system operates in a manner consistent with the nature of the reform. Malian and

Ghanaian schools and the government structures that run them are based on colonial systems that were not designed for the contexts that house them nor for helping Africa to develop and maximize its human and physical resources (Evans, 1994). New kinds of plans should be put in place now that technology holds the promise to empower Africans to participate in global affairs like never before. New policies, progressive discourse, and pilot activities may reflect the groundwork for much needed changes, but the combination of the right context, resources, and support are integral to the success of this kind of system-wide innovation.

A Review of the Literature

To understand how Malian and Ghanaian education systems can or cannot handle information technologies, it is important to explore the role and value of IT in development and in education, and to outline the challenges of the African education context. This review provides the reader with an understanding of relevant issues and perspectives.

IT for Change and for African Development

There are two views on the potential impact of new information technologies: there are those who believe that information technologies will allow the people of the world to finally communicate with one another, and there are those who believe that these technologies will exacerbate the resource imbalance that already exists between the rich and poor (Tehranian, 1990).

The first view asserts that open access to information will lead to the ultimate sharing of ideas—the ideal democracy.[2] In fact, people are already making use of technology to improve participation in elections and public political discourse,[3] and there is talk that national elections will someday be held online. The Internet has been the first communication technology with which people can communicate individually, in groups, or to the world—masses to masses, and every variation thereof. Every other mass communication tool—radio, television, and newspapers—has transmitted a single perspective to the public (Castells, 1996). Castells (1996) asserts that "the most important feature of multimedia is that they capture within their domain most cultural expressions, in all their diversity" (p. 372). Because IT enables this interaction and sharing of ideas across cultures, it creates extraordinary opportunities to "empower the continent [Africa] out of the vicious circle of poverty, low growth and the degradation of natural and human resources" (Oshikoya & Hussain, 1998, p. 120).

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[2] See for example Malian President Konaré's speech "Africa and the New Information Technologies," given in Geneva, October 1996, http://flani.malinet.ml/anais/koulouba/discourspub.html.

The opposite perspective alleges that information technologies will exacerbate the rift between the haves and the have-nots.[4] After all, how can someone participate in an online democracy if he/she cannot read? If a computer costs more than one makes in one year? If one has never used a telephone for talking? New technologies are surfacing to accommodate illiteracy and the lack of telecommunications infrastructure, and rural telecenters are being established to give people access to them. But, if the political and economic systems are not designed to hear the voices of the disenfranchised, the Internet will likely not help their voices to be heard. And if there are barriers to people's understanding of problems like AIDS or the necessity of educating girls, the Internet is not likely to be the influence that changes their minds.

Economic studies about IT use are optimistic but cautious about how these technologies will affect developing countries. Because of the rising global nature of economic interactions, they will need to change the nature and manner in which they build their economies of the future. They will need to be competitive in "a new world economy that is global, high-speed, knowledge-driven and disciplinarian" (Haddad, 1997, p. 36), requiring a long term plan for building the knowledge, skills, and infrastructure needed to move from being players in local markets to participating for their best interests in global ones. "Development policy should therefore encourage activities that may not have the highest payoffs today, but which build capabilities for the future. Familiarity with modern information technology may be exactly such a capability-enhancing activity" (Lucas as cited in Canning, 1999, p. 12).

Castells (1996), in his discussions about the new economy and Africa, talks about the "structural irrelevance" of African economies to the new global economy, citing a number of characteristics that make it incompatible including markets that are too narrow, politics that are unpredictable, investments that are too risky, labor that is not

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[3] See for example Minnesota E-Democracy at http://www.e-democracy.org, and Castells, 1996, p. 362.
[4] See for example *Falling Through the Net: Defining the Digital Divide* (released July 8, 1999 and revised November 1999) by the National Telecommunications and Information Administration (U.S. Department of Commerce), see http://www.ntia.doc.gov/ntiahome/digitaldivide.

skilled enough, and infrastructure that is inadequate (p. 135). However, there are already a number of examples of how markets are opening up in developing countries. For example, artisans are now using the Internet to find new markets and are exporting crafts worldwide.[5] This is grassroots, microenterprise development at its best. But so many factors need to be in place to be able to seize these opportunities, and only so much support and guidance are available. Like education, systemic changes may not be around the corner, but there are applications that show the potential and relevance of IT. The questions is not about whether the Internet will take hold, but rather how it will take hold.

Historically, Africans have not been able to participate in the global economy or in research because of exorbitant communications costs—these countries have been isolated, with most of their information and economic networks available only through their former colonial power. New technologies have begun to open these channels allowing Africans to participate in global networks of all kinds. For example, rice researchers in rural Madagascar can discuss techniques and growing cycles with other experts in the Philippines and Columbia.[6] University libraries that previously had outdated reference materials and serials, if any, now have access to classes,[7] researchers and current resources through the Internet. Equally as important is the fact that Africans are now able to share their own knowledge, experiences, and resources, as well as promote their goods and services worldwide.

Despite the potential that IT holds for Africa, there are two contradictions that inhibit it from being fully exploited. The first contradiction is that this technological tool that holds the potential for African participation in a multitude of arenas relies on resources and expertise that cannot yet be produced in Africa. Unless there is indigenous ability to install it, maintain it, own it, and eventually develop it, Africa will continue to rely on others for the innovation and production of this tool. If the technology can be seized and harnessed for African use, defined by Africans, for African purposes and African

[5] See for example PeopLink at http://www.peoplink.org, Aid to Artisans at http://www.aid2artisans.org, hand-made silk goods from Cambodia at http://www.villageleap.com, and handicrafts from around the world at http://www.main.nc.us/amys/cosmic_vision/index.htm.
[6] See the International Rice Research Institute at http://www.cgiar.org/irri.

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development, then there is nothing lost in the delay in adopting these technologies. This kind of "leapfrogging" is what is cited as what will help Africa "catch up" with the rest of the world (UNECA, 2000). But if Africa follows the lead of the West and tries to adopt Western models of Internet use, Africa will continue to lag behind (Adamolekun, 1996; Hudson, 1984). According to Stover (1984), "what the less developed countries need, most of all, is the physical means to be self-reliant, the resources and information to develop their society, economy, and polity in their own way" (Stover, 1984, p. 55).

A second contradiction in Africa's maximization of IT is that technologies are enablers for the elite to become more elite and the disadvantaged to become more disadvantaged (Thapisa et al., 1998). African governments are not all in favor of free access and flow of information. Information is power, and institutional and cultural communication norms often restrict its free flow (Reimers & McGinn, 1997). Hierarchies are still intact. So, while African governments strive for democracy, the implications of change in the power structures are dramatic; this kind of change will take time and require the buy-in of those involved (Rao, 2000). As a result, open communication and information sharing are not likely to happen in tandem with the proliferation of Internet connectivity (Byron & Gagliardi, 1998; Tedesco as cited in Byron & Gagliardi, 1998).

What is agreed upon is that Africans need to think and plan deliberately and strategically for their use of information technologies (Adamolekun, 1996; Hudson, 1984; Mansell, 1998; Nyamnjoh, 1996; Oshikoya & Hussain, 1998; Thapisa et al., 1998). Building upon existing indigenous communication systems[8] is crucial in the adaptation of these technologies to African needs (Nyamnjoh, 1996). Adamolekun (1996) further emphasizes the need for African relevance and participation by recommending that IT use go beyond promoting consumerism and that the sociopolitical context be considered when planning for its use. He advocates for "a new beginning in developing enduring information infrastructures that would take cognizance of our cultural heritage, literacy

[7] See for example the African Virtual University, http://www.avu.org.

[8] Defined by Ugboajah (as cited in Nyamnjoh, 1996) as media that "are grounded on indigenous culture [sic] produced and consumed by members of a group. They reinforce the values of a group. They are

level, capacity utilization, maintenance, culture and the existing traditional communication system is necessary" (Adamolekun, 1996, p. 33). Berman says, on a similar note, that Africans need to be "active agents rather than passive objects of social transformation" (cited in Grant Lewis & Samoff, 1992, p. 229).

Hudson (1999) and Stover (1984) both recommend creating plans for IT in consideration of the physical resources needed and on a national level alongside economic development—so as to maximize the potential of these tools. "Careful choice and adaptation of technology as well as research and development for indigenous technology shared among Third World countries can foster a spirit of cooperation, self-reliance, and autonomy" (Stover, 1984, p. 78). And Rifkin reminds us, when making predictions about the Age of Access,[9] that "a robust culture is a prerequisite to economic development, not a beneficiary of it" (Rifkin, 2000, p. 245). So Africa, in some ways, is ready for the information revolution. According the United Nations Economic Commission for Africa (UNECA) (1996) and the Organization for African Unity (1999), the starting point for developing African capacity for these new technologies is to develop a critical mass of people with relevant skills.

IT for Educational Enhancement and for Change

Information technologies are being used in classrooms around the world, and there are a range of lessons about its use and effectiveness. To begin, the schools using these technologies need to be clear about the purpose and manner in which they are used and to what end. "The primary motivation for using technologies in education is the belief that they will support superior forms of learning" (Means et al., 1993, p. 1). Planning will help to ensure that the uses are appropriate to the context and the intended goals (Block, 1990; Carnoy et al., 1986; Hawkridge, 1995; Trotter, 1998; UNECA, 1996; Visser as cited in Fillip, 2000).

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visible cultural features, often strictly conventioned, by which social relationships and a world view are maintained and defined. They take on many forms and are rich in symbolism." (p. 10).

[9] Rikfin (2000) stipulates that the next age is the Age of Access, where we will focus on cultural production, where our commercial arena will involve servicing cultural needs.

IT can be used in a number of ways that can be categorized as: an object, an aspect, or a medium (Plomp et al., 1997). As an object, students learn about the tool itself, usually in a computer science class. As an aspect, they learn about the applications of these technologies as tools (word processing, spreadsheets, etc.). As a medium, students use computers and the Internet as educational tools—for exploration, for support, for resources, for communication, and for applying their knowledge (Byron & Gagliardi, 1998; Means et al., 1993; Moore, 1996). This implies more sophisticated, integrated use of IT. There are endless activities for which computers and the Internet can be used in education, including subject-specific software, research, distance education, tutorials, and group projects (that may involve far-away students and classrooms). They also provide a medium for creating resources and materials, thereby not only working with content but developing programming skills as well.[10] Experience from the United States shows that students who use these technologies for simulations and applications learn to test the effects of changing variables and thereby develop higher-order thinking skills (Garcia & Maurer, 1998).

For these kinds of activities to be realized and worthwhile, there are a number of conditions that must be met. First and foremost, the teacher must be supportive of the activities undertaken. Because these technologies are new to education, teacher training is an imperative element to the success of technology use in the classroom (Byron & Gagliardi, 1998; Means et al., 1993; Plomp et al., 1997; Harper, 1987; UNECA, 1996). Teachers need to be comfortable with the tool, and they must have some experience using it and familiarity with the resources available. In addition, the principal and the higher administration in the education system need to understand the use of technology so as to provide the resources for and understand the outcomes of these activities. The cost of the hardware, connectivity, maintenance, teacher training, and teacher time for planning and finding appropriate resources can be an expensive venture and the results may not be seen in test scores (Trotter, 1998). Studies on cost-effectiveness of computers in the classroom have been inconclusive (Carnoy, 1986). According to Means et al. (1993), this

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[10] See for example ThinkQuest at www.thinkquest.com.

is due to classroom variation in computer use therefore making it immeasurable (as cited in Trotter, 1998). In their 1986 study, Carnoy et al. cite variations in hardware and software costs, and technical assistance between countries. They recommend that each country conduct its own analysis before making their decisions. A number of experts assert that there are more benefits in countries where there is a more educated workforce that can take better advantage of technologies and thereby increase their own productivity and opportunities (Welch & Schultz as cited in Carnoy, 1996).

Those who warn against the use of technology in the classroom question its role in the overall purpose of education, the source for the enthusiasm, and the trade-offs in the investment required. Cuban (1997) discusses the value conflicts, asking whether education is only to create employable, productive citizens, while Koblitz (1996) questions whether investments in computers would not be better spent on better pay and working conditions for teachers to improve education overall. The fact that access to IT in education is so uneven and has not yet proven to increase standardized test scores makes it a hard sell as well. In addition, the incorporation of IT into the classroom is often not initiated by a the teacher in response to needs, and it changes the dynamics between students and teacher thus posing further challenges for teacher in achieving their educational goals (Cuban, 1996). Given IT industry support for putting computers in classrooms, the commercial motivation is often cited as possibly inconsistent with educational goals, and Hawkridge (as cited in Byron & Gagliardi, 1998) says that computers may hinder effective learning since they are employed because they are available or fashionable, rather than in ways that can enhance teaching.

On the other hand, Valente (1997) and Tetenbaum and Mulkeen (as cited in Harper, 1987) assert that using these technologies enables learners to process in a manner that helps them comprehend and construct knowledge in a manner that is consistent with the demands of today's society. Not only are computer and communication skills necessary for many jobs, but the kinds of information use that these tools develop is relevant as well. There is consensus in the literature that education is changing in its nature to give the learner more control of their learning (Block, 1990; Byron & Gagliardi, 1998; Means

et al., 1993; Moore, 1996; Plomp et al., 1997; Trotter, 1998; World Bank, 2000). Teachers are no longer the providers of a finite body of knowledge but become facilitators to help students find, package, manipulate, and judge information according to their needs (Block, 1990; Byron & Gagliardi, 1998; Means et al., 1993). As one teacher with the World Bank's WorldLinks Program[11] stated, "The teaching is different, and the class is more interesting, because the teacher becomes a guide, a facilitator for the students" (World Bank, 2000).

These are not the only skills needed to operate in this new information age. People will need to learn how to interact on a global level, likely building international relationships of all kinds. The new education system would emphasize civic responsibilities and "create a relationship between classroom and community that will make all learning relevant to a student's whole life" (Rifkin, 2000, p. 254). For this to happen, the definition of education must change dramatically. It will become "a sophisticated mix of traditional entrepreneurship, clinical teaching, problem solving, and conceptual systems thinking" (Rifkin, 2000, p. 254). Plomp et al (1997) suggest that this evolution will happen in stages. The process begins with substitution of instructional methods with technology performing similar functions, followed by a transition to instructional methods that begin to change in nature, and finally to a transformation to entirely new instructional methods. These changes will need to be accompanied by encouragement of innovative practices and prioritization of appropriate teacher training (Byron & Gagliardi, 1998; Means et al., 1993). These changes imply a completely new definition and conception of education.

Changing Education Systems

Education systems are countries' largest public institutions in terms of the number of people they employ and service. Consequently, making change is a complex process. As these structures are part of the government, they are also very much affected by political and economic factors.

[11] Quote from Ena, a teacher in Chile. The World Bank's World Links for Development Program is a project that provides computers, Internet connections, and content to classrooms in more than 15 countries

> Since World War II, formal education has been seen as perhaps the most powerful means of transforming and improving society. Development and democracy have been universal themes. Education has been seen as the means by which a new society and a new order of political relationships is created (Bagayoko & Hittenberger as cited in Evans 1994, p. 197).

At times, changes in the education systems may be made to legitimize the state or to prove concern for a disenfranchised group (Ginsburg & Cooper, 1991). Changing these systems, then, is not only cumbersome because of their size, but also because of the implications of changes for the political, economic, and social dynamics within the country.

It is difficult to make generalizations about African education systems because they are so varied, but there are a few characteristics that are common to most. Firstly, the colonial experience still very much affects the government's role in education and the structure of the system (Evans, 1994). Secondly, many systems are structured as filtering mechanisms, allowing fewer and fewer students to advance to higher levels (Samoff, 1996; Samoff, 1999). And because many of these systems are underfunded, they become less manageable, resulting in shortages of teachers and materials, and enormous disparities between urban and rural schools (Organization of African Unity, 1999).

According to Samoff (1999), there are now two divergent perspectives on education and development in Africa: one concerned with informing and empowering citizens and promoting equality and democracy, the other with emphasizing skill development for economic production. Ideally, both of these goals should be addressed within the context of each country's development goals and processes, reflecting appropriate, innovative approaches within the existing political, economic, and cultural environments. This is a difficult undertaking.

Learning from others' lessons is a good development practice, but applying imported strategies may not be. The flavor of an education system depends on so many contextual

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worldwide.

factors that reforms need to be tailored to each individual system and often within it. Given the colonial basis of education systems in Africa and the evolution of each of those systems since independence, the need for custom tailoring is especially true. "Unless African educational reforms are consciously underpinned and guided by a vision of society different from the models of the West, Africa cannot even succeed in overcoming the increasing immiseration and suffering of the majority of its peoples" (Senanu, 1996, p. 86). There are many who agree that, while Western models provide lessons, countries need to find their own solutions (Chirot, 1985; Ndoye, 1997; Samoff, 1999). Tedesco (1997), in interviews with educational decision-makers, finds that the goals of education reform are opposite in developed countries than they are in developing countries: the goal of the former is to prepare for the challenges of the future, whereas that of the latter is to make up for the deficiencies of the past. This difference itself testifies to the incompatibility of the imported approaches to domestic reform.

According to Psacharopoulos (1990), there are three reasons why an education reform in Africa may not succeed:

- The intended policy was never implemented in the first place.
- Even if an attempt at implementation was made, it failed to be completed or achieve a minimum critical mass so as to have an impact.
- Although the policy was implemented, it did not have the intended effect (p.16).

He goes on to advise that those involved in the process should be sure that the relationship between the instruments used and expected outcomes can be sustained empirically (as cited in Samoff, 1993) and recommends focusing on research when making decisions (1990). Evans (1994) supports this view, saying that it is important to "develop a workable process for formulating coherent education policies and the capacity to translate policy into realistic investment and implementation plans" (p. 6). But policy-making is rarely a linear process, as these views imply; rather, it involves a number of actors and interests as well as timing (Moulton et al., 1999; Porter, 1995). Moulton et al. (1999) suggest a more "organic" approach that allows more room for negotiation, creativity, and local expertise—thus allowing for innovation, a "growing" and improved education system.

A flexible, organic approach may help to overcome some of the systemic problems that African countries are faced with in education, which are, as described by Chinapah (1989): overall administration, coordination, monitoring and development of educational activities at the sub-national levels within the context of national educational policies (p. 43). These ailments may simply be due to the inflexibility of the system, for example, Samoff (1993) says that, "Since many of the goals articulated by African leaders were deemed difficult to quantify and therefore impossible to test, they were simply excluded from the agenda" (p. 191). How indeed are education systems to encourage the equality, democracy, and skills development for economic production that Samoff advocates if those within the system must define their needs by strict parameters and processes?

Situating This Study

The literature puts forth both the potential and the challenges that IT offers African education. While the systems are seemingly not equipped to make innovative changes, there is reason—and some argue that there is the ability—to make it happen anyway: "Emerging education technology provides a window of opportunity to revitalize education, training and learning in Africa" (Dzidonu, Rodrigues, & Okot-Uma as cited in Adesida, 1998). This study presents an approach to examining whether this can be done on a systems level, to the benefit of African development.

Conceptual Framework: Considering Both Resources and Intentions

Rather than asking why IT has arisen as an issue in African education, this paper recognizes that this is the case and examines what is necessary to maximize its use. However, to frame the issue, the following is an examination of three different theories that attempt to explain how education changes are diffused globally—dependency theory, institutionalism, and functionalism. These are important in understanding the external influences on IT adoption. The approach used in this paper takes this further by examining the next step: the adoption and adaptation that takes place within countries' education systems. The reader thus gains an appreciation of both the external and internal influences on IT use in education in Mali and Ghana.

Diffusion and Its Theories

International systems theories explain relationships between countries, and how they influence one another. Through his world systems theory, Wallerstein (1973) provides some background to dependency theory. He argues that the strength of a country depends on the structural role it plays in the world economy and that the world economy is the only world system and is "by definition capitalist in form" (p. 415). Similarly, dependency theory is based on imperialism and capitalism, but it provides a framework for talking about contemporary change in developing countries (Carnoy, 1974). Dependency theory asserts that development does not occur in a linear fashion according to the processes undergone by others, but that, in the case of a developing country, this process is ultimately dependent on the nature of its relationship with the developed countries. All countries are a part of the same system, and "…there exists a difference […] of function or position inside the same international economic structure of production and distribution… a structure defined by relations of domination" (Cardoso & Faletto as cited in Carnoy, 1974, p. 53). According to this perspective, the adoption of IT in developing countries may not occur in the same manner as it did in the West, but its diffusion will occur in such a manner as to ensure the continuation of the dominant relationship that developed countries have over developing ones. This may hold particularly true if developing countries rely on developed ones for the supply of IT.

Instead of one world system structured by economic position, institutionalism explains the transnational proliferation of world models on the basis of culture, arguing models and blueprints become "highly legitimated and professionally articulated visions of progress" (Ramirez, 1997, p. 50). Information technologies' use in education falls within those world models. Even though they are not proven to improve the quality or delivery of education, the required skills are deemed valuable in today's economy. By adhering to the progressive models, the state gains legitimacy as the institution creating needed human resources in the global context, even if they are not relevant to the current state of education or infrastructure.

Functionalism is different from the international systems theories, explaining that actions are organized to lead to predetermined goals with maximum efficiency (Scott, 1987). Much of the literature outlined in the review above adheres to this theory by citing African adoption and adaptation of IT as an efficient path to development. By planning for and using IT carefully in an education system, African countries can position themselves to maximize their resources. It should be noted that this perspective is still framed by international systems: the goal—development—is still being defined within the world models and according to desired skills as set forth by the world economy.

IT is a foreign influence on Africa, and African systems are not yet in a position to take full advantage of the resources IT has to offer. It makes sense, then, to explain the diffusion of IT to Africa through the international systems perspectives, and to point out that there are visible external influences. In spite of these influences, there are internal reasons for how African countries are adopting and adapting IT to their educational needs. For this reason, the approach taken in this study examines the capacity of the national education systems to diffuse IT within Mali and Ghana, in an effort to identify what conditions exist in harnessing the potential of IT.

The Approach

"It is important to understand the capacity of African education systems to support IT use in a way that maximizes its benefit, as working through the system is the only way to assure that all levels are affected" (Ba as cited in Fillip, 2000, p. 30). The system, therefore, is taken as the unit of analysis for this study. It is defined as "the way the people in a given society carry out all activities relating to education. [...] The educational system of a country therefore comprises not only the school system but also the administrative machinery set up to ensure the smooth-running of the school system" (Adeyinka, 2000, p. 4). So though the schools and the school community are the focus of the implementation, it is equally important to develop the education institution itself, to assist it to become efficient, and to enable it to encourage creativity and innovation within. The Ministries of Education understand the power and value of IT and have access to it so that they are best able to promote it within schools (Ginsburg, 2000; USAID, 1999). If this happens, African education systems will be ready to embrace change by allowing for synergy between the levels of implementation and thus creating their own models and developing according to their own goals.

This study asserts that both the system's resources and intent should be considered when measuring how well the system maximizes IT use and harnesses its potential for development. This approach combines other perspectives that consider either the needs (Fillip, 2000; Oshikoya & Hussain, 1998) or the motivation for using IT. In this way, it is possible to ascertain not only whether the system can provide the support necessary for IT use, but whether it can encourage the innovation needed for Africans to use the technology to their advantage. Both of these elements are important if a country is going to develop its human capacity strategically, and within a national vision for development.

The Conditions

Based on practitioners' lessons about resources (Byron & Gagliardi, 1998; Means et al., 1993) and the literature's critique of the indiscriminate application of Western models, the following indicators capture what is necessary for an education system to promote IT use and what is necessary for it to encourage innovation for making IT relevant.

Awareness, access, and applicability measure the real and potential resources in the system, while African adaptability and the importance of advocates measure the real and potential intent of the system.

Awareness, Access, and Applicability

Because implementing systemic change is a difficult process, it is important to know what constitutes an ideal environment. Walker (as cited in Byron & Gagliardi, 1998) lists the preconditions for a successful introduction of IT into an education system:

- an appreciation by government of the financial, resource and operational requirements and the resulting consequences;
- a commitment by government to give time and take responsibility for decision-making and implementation strategies;
- commitment to a policy of an integrated support service encompassing teacher and technician training, curriculum and assessment - together with software and hardware provision.

These preconditions encompass the resource requirements. There is consensus among practitioners and researchers about what these requirements are. They have been categorized in many ways: organizational, financial, human, institutional, and/or technical (Means et al., 1993; James et al., 1999). For the purposes of this study, the requirements stipulate conditions that fall into three categories: awareness, access, and applicability.

Building awareness should include all stakeholders in education, at all levels of the system. It is imperative that everyone (administrators, principals, teachers, parents, students) be aware of the costs and benefits of computer and Internet use and understand the value and relevance of these tools. It is only in this way that those stakeholders will take the actions and make the investments needed at all levels to successfully integrate IT into schools.

Governments must back their support of IT integration with tangible actions. In education systems like those in Mali and Ghana where resources are scarce, policies and resources are integral in enabling stakeholders to begin new activities. This support provides the guidance and endorsement needed. Without these things, many fewer

schools will take on this challenge, and those who do will do so at their discretion and according to their goals and means.

To assure access to these IT tools, schools must not only have adequate hardware and software, but also available technical assistance for maintenance, breakdowns, and upgrades. If the school is using the Internet, it is wise to have a separate line for this connectivity, which will incur a monthly cost (varying prices depending on the kind of connection) in addition to the monthly Internet subscriber fee. In a number of African countries, the quality of the phone line is not adequate for data transmission, and Internet users are often frustrated by frequently cut connections. Secure, temperature-controlled space is recommended if a school invests in computers.

Before integrating IT into the curriculum, special attention and planning must determine the goals of using these tools and the resulting appropriate activities. Without a plan, it is easy to become unfocused and thereby find it difficult to justify IT use as a supplement to other learning activities. Teachers are the integral part of making these activities applicable and must be given training and time to integrate the Internet into their classes effectively. They must have repeated opportunities to become comfortable with the tools, explore the various kinds of resources available, and share experiences with other teachers (Means et al., 1993). There must also be class time for using IT.

To facilitate these favorable conditions, Ministries of Education need to understand the kind of support needed to overcome the challenges schools and classrooms will face. They must endorse the time and resources spent with the same conviction that Konaré and Rawlings describe their understanding of the need to develop manpower for global participation. This support must trickle down through the levels of the education system, enabling the kind of innovation sought after by those leaders.

<u>African Adaptability and the Importance of Advocates</u>

Overarching all of these factors must be a progressive ideology that drives the policies and activities. Konaré (1996) describes the need for breaking away from colonial models

and being innovative; the literature, too, asserts the need for learning from others but developing approaches unique to the context. Given Malian and Ghanaian contexts, Western strategies and applications cannot be imposed to achieve maximum results. This is especially true for IT, a tool that has the potential to empower African development. Experimentation and innovation are key to harnessing the utility of IT for strategic development in Mali and Ghana.

Infusing the system with innovation requires advocates throughout continually catalyzing and encouraging the next steps of the process. Advocates need to have a more visionary understanding of why investing in IT is needed so that they may justify the need for investing and being tenacious with the integration of IT. Survey respondents are examples of advocates in Mali and Ghana. As discussed above, there are often political, economic, and cultural barriers at all levels of the process that prohibit policies and programs from being implemented (Harper, 1987). The risk of IT falling by the wayside is lessened by having dedicated people working within the context to find appropriate solutions to challenges and to persist when enthusiasm wanes. Without these people, the challenges become barriers, and the potential fades.

These Conditions as a Guide

To examine both the resources and intent in the education systems in Mali and Ghana, this study includes data that was gathered and analyzed according to the five conditions outlined above. A more detailed description of the data and methodology is included in the following section.

Data and Methodology: Comparing Case Studies

To capture both the real and potential ability for education systems in Mali and Ghana to harness IT, four kinds of information are included in this study providing context, opinion, promise, and activity. Of six possible sources of evidence (Yin, 1994), two were used in this study: documentation and surveys. Archival records did not apply, as this is not a historical study; direct observations, participant observations, and physical artifacts were not used, due to the limit on travel and time. The two sources used provide a combination of fact and opinion, as well as broad coverage and targeted information about the topics studied. While every effort was made to include all relevant documents, data, opinions, and activities in this study, there are inevitably some that are missing. However, consultation with a variety of experts in the field assures representative information herein.

Case Studies

Both the research strategy and the presentation of the information are based on the case study method. The conditions and indicators stipulated for IT use in education systems provided a guideline for compiling content, giving some precision to the narrative (Yin, 1994). Case studies include the most current information possible, and every effort was made to be consistent with the information provided for each country. The organization of the case studies begins by describing education in Mali and Ghana and is followed by a description of the system and the factors that contribute to the situations. Because IT is defined to include Internet use in this study, a profile of the telecommunications sector follows, describing access and expansion of these services. Together, these give the reader an overview of the context and its viability for integrating IT into the systems—indicating the existing and potential resources available.

To capture intentions, the case studies include survey respondents' informed opinions about the education systems and potential for IT within them, selected pieces of leaders' public discourse about the need and potential for IT, and descriptions of relevant activities being conducted. The combination of these is evidence of the attitudes of those

in power to make changes, and the changes being made as a beginning and providing lessons, examples, and inspiration.

This study is written as two single cases with an initial cross-case comparison and more rigorous factor analysis that examines each case against the stipulated indicators. This kind of explanation building has an iterative nature (Yin, 1994), but this study only begins the process by comparing the findings of a case (in this study, two) to an initial theoretical statement or proposition. Revising the initial proposition according to findings from other cases is left to future research studies.

Data, Studies, and Analyses

The profiles are constructed from a number of sources for each country including data about the education system, international aid donor reports and analyses, policy documents, reference materials, and web sites from the Malian and Ghanaian governments and other organizations working in this arena. These documents represent a number of views but collectively provide the history and context of today's reforms and the details of the reforms themselves.

Policy documents from Mali and Ghana's most current education reforms were analyzed for this study (see Table 1), and relevant information was included. Much of the detail given in these documents, including the quantified specific goals of each intervention, was not included but rather summarized to give the reader an appreciation of those goals. In addition, policy reviews and critiques were used to identify emphases and weaknesses, respectively.

Title	Author/Institution	Date
Mali		
PRODEC: Amendments to Directions in Education Policy	PRODEC Pilot Committee: Technical Division	June 1999
Work Plan for Priority Actions for PRODEC 1998-2000	PRODEC Pilot Committee: Technical Division	June 1999
Implementation Specifications	PRODEC Pilot Committee: Technical Division	September 1998
PRODEC: The Clarification Process	Government of Mali	May 1998
PRODEC: Directions in Education Policy	Government of Mali	May 1998
Ghana		
Comprehensive Framework: Education	Ministry of Education	November 1999
Ghana: Free Compulsory Universal Basic Education Programme Report on the Mid-Term Evaluation of the School Improvement Fund Pilot	Ministry of Education International Development Association (IDA) Department for International Development (DFID)	July 1997
Basic Education Sector Improvement Programme for Achieving Free Compulsory Universal Basic Education by the Year 2005 Programme Digest 1996-2001. Volume 1.	Ministry of Education	April 1997
Basic Education Sector Improvement Programme: Policy Document Free Compulsory Universal Basic Education by the Year 2005. Volume 1.	Ministry of Education	April 1996
Towards Learning for All: Basic Education in Ghana to the Year 2000. Education Sector paper as a Follow-up to the National Programme of Action	Ministry of Education	April 1994

Table 1. Policy Documents Included in This Study, Mali and Ghana.

As a piece of each profile, details about the telecommunication sector are included to show the capacity of the infrastructure and the accessibility of the services throughout Mali and Ghana. Brief descriptions of reforms are included to reflect the priorities of the telecommunications providers and their understanding of the unserviced demand.

Statistical data should be read with caution as the mechanisms for collecting these kinds of numbers in African education are not always consistent (Samoff, 1999), and the fast-changing nature of the telecommunications sectors makes those numbers hard to capture as well. The numbers do, however, paint a picture that helps the reader understand the overarching characteristics of these sectors in Mali and Ghana.

Many of the reports cited in these profiles are funded by international aid donors, and donors also play a significant role in the policy-making process. This perspective is an important one to understand as many of the ideas and much of the funding for education come from these external sources. Many of the reports included were written with the assistance of the Ministries of Education, or at least their cooperation, but some are purely from an external perspective.[12]

Perspectives

Advocates were surveyed to capture their perspectives (see Annex 2 for the survey questions). These actors were selected from a number of kinds of organizations, including the Ministries of Education, NGOs, international donors, Internet service providers, and private sector businesses. These individuals were selected because they are the advocates for IT in education in their countries, a method known as purposive sampling (Cohen & Manion, 1994), and they are often the ones who have invested in activities and programs in this arena. One inconsistency is that respondents were not chosen from the same organizations or positions in both countries, but rather for their involvement with IT in education and their willingness to participate in answering the survey questions. In many cases, this kind of consistency was not possible as the positions in the Ministry or the organizations did not parallel one another in Mali and Ghana. However, because this study intended to capture the opinions of advocates—a role not dictated by position title—this approach was more effective in identifying them.

[12] For more information about the implications of participants and authors of donor-funded studies, see Samoff, 1996.

Having worked with IT in education for four years with USAID's Leland Initiative in a number of African countries, including Mali and Ghana, the author counts many of the respondents among her former colleagues—indicating that they have worked in partnership with donors in the promotion of IT in education. Others were identified based on respondents' and experts' recommendations, a method known as snowball sampling (Cohen & Manion, 1994). All respondents were Malian or Ghanaian; many have advanced degrees from Western institutions and most worked on projects that received international donor funding. Perhaps their awareness and dedication comes from their overseas experiences or quest for funding, and so their conceptions may therefore be based on Western models.

The survey questions were sent via e-mail or fax, and in most cases, followed up by phone conversations to assure that the messages were received and that the respondents understood the scope of the study and the role of their answers. Surveys sent to Mali were in French (with the exception of Respondent Mali#2), those sent to Ghana were in English. The questions were designed to be open-ended to solicit the opinions of the respondents about the education system and IT policy. Because the questions were open-ended and did not limit or define terms (e.g., "success"), responses may mean different things. Initial correspondence included a request for continued dialogue, if needed, for clarification. This was not necessary. The responses illuminate the structure of the education system and current policies, and they make up the section on advocates' thoughts about IT policy in education. Respondents were specific about their thoughts, and identifiable themes could be gleaned from their answers. However, because the questions were open-ended and were answered by correspondence, respondents' answers differed in detail according to that with which they were most familiar. Because the responses were used primarily to identify themes, this format was ideal in capturing the respondents' central thoughts on the issues raised. This format also limited potential bias on the part of the author, as all respondents were given the same questionnaire and the same instructions.

Because respondents' identities are concealed in this study, each was coded with their country and a number for citation purposes. This allows the reader to identify each respondent throughout the study, without divulging their identities.

Discourse and Activity Descriptions

This section is included in this study to provide evidence of high-level rhetoric about and small-scale implementation of IT activities in education. This is a part of the study that provides a representation of this evidence, not an exhaustive study. This representation talks to the specified conditions and indicators, demonstrating that leaders display an understanding of the potential of IT and that activities exist and what conditions exist so that they are able to operate.

Information for both discourse and activities were found on the World Wide Web. The leaders' discourse is hosted on Malian and Ghanaian web pages, a public record of what was said. Passages were selected based on their relevance to the conditions stipulated, and themes were identified. Activities were chosen based on the author's previous familiarity with the topic and from the survey respondents' answers. In selecting these activities and programs, an attempt was made to represent a range of organizations involved. Actors and activities are categorized and discussed. The author admits bias in this selection, as many of these were partners in or products of the author's work previous to this study. Again, information about these programs was found on the World Wide Web; no privileged information was used.

Comparisons

Because the same information was included for both countries, a section comparing each of the elements was included to conclude the profiles. This overview provides the reader with a synthesis of the similarities and differences between the countries, framing the analysis and conclusions.

Factor Analysis

The case studies and comparison provide the reader with a comfortable introduction to the contexts in which this study is housed. Because of the level of detail depicted when using the case study method, this method does not allow for generalizations (Abercrombie et al., 1994). However, by applying the information in the case studies to the stipulated conditions by using factor analysis, a level of generalization can be achieved so that some conclusions can be made about IT integration in education systems.

Factor analysis "is a way of determining the nature of underlying patterns among a large number of variables. It is particularly appropriate in research where investigators aim to impose an 'orderly simplification' upon a number of interrelated measures" (Cohen & Manion, 1994, p. 330). This study determined the conditions needed for integration of IT into the education systems and will evaluate the feasibility of this in Mali and Ghana based on the information collected. To do so, specific indicators of each of the conditions are included in the analysis, and justification of why each piece of evidence fits the indicator. A more thorough exploration of the indicators will result from including and comparing Mali and Ghana. Unlike the method used in Cohen and Manion, this study does not attempt to quantify the indicators, but rather uses the qualitative evidence at its face value.

Mali and Ghana will be analyzed according to the conditions so that they may be compared. According to Ragin (1994), "the goal of comparative analysis is to determine the combinations of causal indicators that differentiate sets of cases" (p. 116). Again, this analysis will not include quantitative measurements. Instead, this comparison will be qualitative and will allow for conclusions to be made about the countries' potential for integrating IT into the education system and about the validity of the indicators.

Findings and Implications

To best understand the context and to analyze the capacity of Malian and Ghanaian education systems to integrate IT, this section first provides profiles of each country that include characteristics that reflect the resources available and the intent of the systems. Included in these profiles are the following sections:

The State of Education. This overview of the conditions of education today indicates how well the system is servicing the needs of the people. Enrollment rates, teacher-student ratios, and discussion about the problems that plague the systems give the reader an understanding of who benefits from education, what those benefits are, and what the problems are according to those who administer the systems.

The Education System. Some background on the nature of the system is important in explaining the current state of education and how the system functions. This section outlines the current education reforms, providing the reader with an idea of the countries' educational goals and priorities. These reforms indicate whether IT is included or being planned for—or at least if these reforms consider the kinds of changes that IT would require and produce.

The Telecommunications Sector. An understanding of the extent to which telecommunications services are accessible to Malians and Ghanaians will show whether the Internet is a possibility for most schools. While IT is not exclusively Internet use, the availability and exchange of information is included in the definition of IT for the purposes of this paper.

IT in Education. This section depicts Malian and Ghanaian inclination towards integrating IT into the education sector. Since both countries' policies are in their formative stages, the thoughts of key people and the pilot activities give an indication of whether IT is being thought of as a possibility, how it fits into education plans, how it is being endorsed, and under what conditions it can be done. While much of the

information contained in this section is about individual—not systemic—perspectives and activities, it is important to include it to show what has been put in place.

The section following the profiles compares Mali and Ghana to give the reader a synthesized view of the similarities and differences between the countries in each of the areas outlined above. This synthesis is useful for framing the analysis section that follows where information from these sections will be measured according to the five indicators previously outlined: awareness, access, applicability, African adaptability, and advocates. This analysis uses the information in the profiles to evaluate Mali and Ghana according to the stipulated requirements for harnessing the potential of IT through education on a systemic level.

Mali

> Mali inherited a formal educational system ill-suited to its societal and economic requirements, and policies since independence in 1960 have severely aggravated this fact to the point where Mali's basic education simply cannot and does not meet the needs for a society striving for sustainable development and democracy (Charlick et al., 1998, p. 3).

The inability of Mali's education system to provide for its people's educational needs has serious implications for the future, especially in a country of over ten million people, more than 60 percent of them under the age of 25 (USAID, 2000b). In Mali, there is sufficient room in the primary schools for less than half of school-aged children. Class size, on average, is 70 students with just one teacher—there is a severe shortage of teachers (Government of Mali, 1998; Respondent Mali#4). If you make it to secondary school, only one in every ten of your friends will be joining you. Less than one third of all girls are in primary school, and only one of every fifteen make it to secondary school.[13] One out of five students repeats a grade. If you are smart enough to test into secondary school, you may not live near home as 40 percent of the general secondary schools and 70 percent of the technical schools are located near the capital, Bamako[14] (Ouane, 1995).

An Introduction to the Education System

The list of ailments of the current education system is long, and the mismatch of the systems and the country's needs is evidenced by the prevalence of both undereducated and overeducated Malians. Insufficient human and financial resources prohibit Mali's education system from responding to the need for adequate and appropriate teacher training, a better supply and distribution of school facilities and materials, timely payment of teachers' wages, and adequate administration for the effective and efficient running of the decentralized education system (Bagayoko & Hittenberger as cited in Evans, 1994; Charlick et al., 1998; Moulton as cited in Evans, 1994; Ouane, 1995). In

[13] Unless otherwise noted, the data in this paragraph is from UNESCO's 1999 Yearbook. Please see the note about the data on page vii.

[14] Because this paper studies the formal education systems, it does not include private or religious schools, including medersas (Koranic schools).

addition to this inadequate system, there is a fundamental economic problem: the poor relationship between the skills of secondary and tertiary institution graduates and the employment opportunities available (Bagayoko & Hittenberger as cited in Evans, 1994; Charlick et al., 1998; Ouane, 1995). This is largely due to the structure of the system, having evolved from the colonial system inherited at independence—one that was designed to train a few Malians to become civil servants (Evans, 1994; Ouane, 1995). Barthélémy Togo, the official in charge of primary education for the new ten-year education plan (PRODEC), said recently in an interview with *The New York Times*,

> There is no relation between the needs of our economy and our educational system. Our educational system is directed mainly toward producing civil servants, and that is still the situation in many French-speaking countries in Africa. Schools in those countries are considered for the elite. They are not regarded as belonging to the local populations, but as something imposed on them (Onishi, 2000).

Because the education system is not meeting Malians' current needs, the government is encouraging towns and villages to build primary schools and hire teachers (Onishi, 2000). This push for community ownership of schools began in 1995 with an MOE policy instituting New Primary Schools (Nouvelles Écoles Fondamentales, NEF), where a more active and non-formal approach was taken to pedagogy and an emphasis was given to using maternal languages alongside French. Since much of these new methods were foreign to Malians' concept of schooling, these reforms were not well received (Charlick et al., 1998). In spite of this, gross enrollment in primary education grew from 28.8 percent in 1991 to 43.6 percent in 1996 (Government of Mali, 1998a). Many of the NEF reforms have been incorporated into the latest plan, and community ownership and management of schools continue to grow.

PRODEC: The Current Plan for Education

The Malian education system is characteristic of Francophone systems in that each educational policy reform since independence has been prompted by political crises (Evans, 1994). Each time a new ruling party takes charge, an educational conference is held, and new goals and reforms are determined. Bagayoko and Hittenberger suggest that these kinds of forums not only publicize the ruling party's political control and

ideology to differentiate itself from the former regimes, but they also provide an opportunity to discuss the national ills and what can be done to remedy them. The implied concern about the nation's children and its future make this demonstration particularly powerful (Bagayoko & Hittenberger as cited in Evans, 1994).

In 1991, with the beginning of the transition to the Democratic Regime (though before the elections), a National Debate and Conference on Education was held in an effort to promote democracy and broad-based participation. Prior to the conference itself, the Ministry of Education's regional inspectors organized local workshops with all constituents—parents, teachers, community associations, unions, and political parties—to discuss the issues after radio and television broadcasts had informed the public of the bleak realities of the state of education in Mali at that time (Bagayoko & Hittenberger as cited in Evans, 1994). Education reform had traditionally been a function of the state with little participation from other constituents (Bagayoko & Hittenberger as cited in Evans, 1994). The Democratic Regime has however kept with the participatory spirit by involving donors, all levels of government, NGOs, the private sector, teacher and student unions, APEs, community associations, professional associations, and other political party members into the new policy reform process (Charlick et al.1998; Government of Mali, 1998a; Government of Mali, 1998b; Respondent Mali#3).

The current national education reform is a ten-year plan titled the Programme Décennal de Développement de l'Éducation (PRODEC). PRODEC intends to expand access to education and meet the country's development needs. Under this regime, Mali has been decentralizing the government, and PRODEC outlines this plan for education by empowering regional and local authorities. A long-term, complementary communication strategy has been designed to ensure two-way information flow throughout the system during the entirety of the plan, which is critical to the success of such large-scale reforms. PRODEC addresses the entire education system at once, instituting reforms at all levels: pre-school, primary education, non-formal education, secondary education (general and technical, and professional), and tertiary education (Government of Mali, 1998; Government of Mali, 1998a; Respondent Mali#2). In addition, the plan's budget

redistribution increases the money allocated to primary education from 57 percent to 59 percent and decreases the amount for higher education from 18 percent to 14 percent (Charlick et al., 1998). This kind of undertaking requires enormous financial and human resources that, according to one survey respondent, Mali may not be able to handle (Respondent Mali#2).

PRODEC emphasizes rural access to schooling, instruction in maternal languages, an emphasis on basic education and access for girls, and a need for increased efficiency of the administration (Evans, 1994). The overarching goals of this plan are summarized as follows:

- Improve the quality of teaching;
- Improve teacher training;
- Increase admission capacity;
- Improve the management of human, financial, and material resources; and
- Improve awareness of schooling.

In developing the plans, the PRODEC team embarked on a study tour of six African countries to review their national education strategies. In conjunction with what was learned on the tour, the team undertook a participatory process that included Malians from 78 locations countrywide to help create the policies (Respondent Mali#2). As a result, the policies include a series of short- and long-term plans for executing changes that touch on many aspects of education throughout the country. The 11 priorities are:

- Quality basic education for all
- Professional education adapted to the needs of the economy
- Revised and effective secondary and technical education
- Quality higher education that takes priority needs and set costs into account
- The use of maternal languages in formal education, alongside French
- Feasible policies for providing books and materials
- Teacher training policies
- Productive partnerships created around schools
- Institutional restructuring and adjustment for reform of the education system
- Communication policies focused on dialogue and involving all partners
- Financial policies that develop the education system taking into account the macro-economic context, the redistribution of resources between levels of education, the management of a number of budgets, and the management of multiple funding sources especially decentralized bodies, communities, and the private sector.

Technical secondary, professional secondary, and tertiary education all address the need to build skills relevant to the Malian economy. Technical education has programs designed to satisfy immediate production needs (Government of Mali, 1998a), whereas professional secondary education and universities are beginning to integrate IT. The former offers classes in office computer use (Respondent Mali#3), and the latter are planning to make information technologies available to their faculty and students—with the pilot phase of the African Virtual University dating back to November 1997.

There are some red flags in this plan. To begin, Mali's MOE is still highly centralized, as efforts to decentralize have been slow. It is not surprising, then, that in spite of the information and communication strategy in place, there are already problems with implementation due to the abundance of actors and activities (Respondent Mali#2). And while the first five years of PRODEC are heavily financed by international donor organizations (Government of Mali, 1999), there are questions about where continued funding will come from (Government of Mali, 1999a; Charlick et al., 1998). There is little hope that Mali's private sector will rise to the occasion, as they have continued to shy away from participating in the education sector (Government of Mali, 1998). With uncertainty about future resources and the shifting power structures due to decentralization, the long-term plans are not clear about the role of the state and its various levels of authority (Charlick et al., 1998). This will seriously impact the implementation of PRODEC's reforms.

The Telecommunications Sector[15]

Mali has one telecommunications provider, SOTELMA (Société de Télécommunications du Mali), that will soon be privatized. SOTELMA was founded in October 1989 and has been managing the country's Internet connection since 1996, furnishing access to the country's estimated 1000 Internet subscribers[16] through five privately-owned Internet

[15] Unless indicated otherwise, the data is from the ITU with the year noted, and the currency is in U.S. dollars.

[16] This number indicates the number of accounts; the number of users varies for each account but can be, for example, all of the employees of an organization.

service providers (ISPs) (Jensen, 2000). ISP costs for Internet connectivity from SOTELMA are the lowest in the region (USAID, 2000a).

Mali's telecommunications infrastructure is weak: it has 12,300 total telephone lines for its 11.13 million people, which equals .19 lines for every 100 people (1996). The distribution of these lines is almost exclusively limited to urban areas (96.5 percent), where 26.9 percent of the population resides (1995). Public availability of telephones is limited in Mali as well; there are .05 public telephones for every 1000 people (1996). However, Mali's domestic satellite system (DOMSAT) provides high-speed, high-quality telecommunications access to six cities in Mali outside of Bamako.

Telecommunications costs are not affordable for most Malians. Based on a GDP per capita of $238 (1995), annual residential subscription fees for a telephone line are 19.1 percent of the GDP per capita (1996). A three-minute call in the same area costs an additional 17 cents (World Bank, 1999). Monthly subscriptions for Internet access range from 10,000 CFA (about $13.80[17]) to 60,000 CFA (about $82.76), depending on the ISP and the kind of access desired. In addition, hardware and software are subject to import taxes[18]; though even at their least expensive price tags in the United States, they are well beyond what most Malians can afford. However, for those who communicate internationally on a regular basis, this investment in hardware and fees may save money in the long term, as the cost of a three-minute call to the United States is $15.42 (World Bank, 1999).

In an effort to ease costs for Internet users outside of Bamako, SOTELMA established a system in which users pay only local line charges to their ISPs from anywhere in the country. This was a necessary policy, as Bamako is the only POP[19] in Mali.

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[17] Mid-August 2000, the CFA (French West African currency) was valued at 725 to $1.00. See http://www.africaonline.com/index1.html.

[18] Import taxes indicate that governments may not consider hardware and software as tools for development, but rather as commodities (Canning, 1999).

[19] Point-of-presence: a telecommunications center connected to a gateway, providing local Internet access (i.e., a long-distance call is not necessary). In Africa, POPs are often found in secondary cities.

About IT for Education

While policies in promotion of IT activities in education have not yet been created in Mali, there is support for them. The following section includes Malian President Konaré's public endorsements of the value of IT for African and Malian development and the thoughts of selected advocates in the area of IT in education. These statements reflect awareness of the value of IT and the actions required among those who are able to mobilize people and resources. Also included in this section are brief descriptions of pilot activities, demonstrating what is currently feasible in Mali.

On Behalf of President Konaré

The following are excerpts from President Konaré's speeches that are relevant to education and IT. This discourse is selected to highlight Konaré's thoughts on IT and development and to cite how he finds it useful to the education sector. This discourse, because it is public, indicates an awareness of the importance of this kind of development and may incite action.

Konaré (1996) cites what is at stake for Africa, and particularly Mali, in all sectors of development, emphasizing the essential role of democracy in development and the importance of IT in promoting democracy and decentralization at a conference in Geneva in October 1996 entitled "Africa and the New Information Technologies":

> The decentralized communities, reflective of integrated communities, will be the best living laboratory of the democratic experience. Extending throughout the entire nation (nearly seven hundred municipalities in all), management of delegates, harmonization of national policies, training for the elected, experience-sharing between municipalities, nurturing of foreign relationships—all of these beg for effective, fast and modern communication tools (author's translation).

In the same speech, he talks about the challenges needed to overcome the barriers to IT use, so that Africans may reach their potential:

> Being in my position, I know how difficult this is to do in the long term. I know how much you have to believe in its necessity to feel that you must overcome all of the obstacles. But, to liberate Africa, there is no other

> solution but to liberate the energy of Africans, without malice and without deception (author's translation).

Two years later, at the launching of the Year of African Education, he talks to another long-term goal for development: the need for innovative educational development.

> "We should dare, we should risk innovating." We should provoke, finally, the break, the necessary, indispensable break with the colonial School. On this road of responsibility, one towards the future, we are allowed to make mistakes. We know how to turn them into successes.
>
> The New School, the School of open-mindedness, your School and his School are a democratic requirement today, it is the condition of our development (author's translation) (Konaré, 1998).

In support of IT in Mali and all of Africa, Konaré hosted a conference in February 2000 in Bamako to bring leaders together to draft concrete actions for using IT for development. The goals of this meeting titled "Bamako 2000" were:

- To closely examine how ICTs have been utilized to achieve development goals in a wide range of sectors
- To establish realistic and sustainable benchmarks for implementing ICTs in Africa
- To propose concrete measures and actions, uniting NGOs, the private sector and other partners for taking full advantage of ICTs in Africa (see http://wwww.bamako2000.org)

The resulting action plan touched all sectors of development and addressed the need for ICT training and strengthening of skills by outlining the need to incorporate this kind of training in existing training programs, to train trainers, to provide the necessary equipment to existing training centers, and to create tools and manuals (including those for distance learning). These efforts must be directed toward youth, women, and public relations professionals.

The declaration made on behalf of Malian youth described the problems they face with education and employment and appealed to the conference participants to proliferate broad access to these technologies, for the whole population, but especially the youth.

In his closing speech, Konaré committed to a plan connecting the 701 municipalities in Mali.[20] He also again talked about African responsibility for harnessing information technologies:

> the image of our societies and cultures will really come out only when we assume responsibility for this phenomenon of modernisation, which is nothing other than the competition for excellence. [...]
>
> For, we are aware of the enormous danger for Africans in restricting themselves to gulp up new current key contents, which are conceived all over for them today. In good faith, some good friends are competing in expertise to trace the destiny of our educational system, paving the way for the training of our elite and the equipping of our populations. Once again, with the Internet, and even more so, co-operation could be of help to Africa. The old reflexes of cultural colonisation and economic alienation could reappear with new methods. A fundamental intellectual reflection is therefore becoming evident, almost a mastery of new speech technology, which helps us to map out our own path. This is why I repeat with emphasis what I said in Geneva and Addis Ababa: the presence of strictly African contents to solve African problems is the only guarantee of deriving any benefit from NICT (Konaré, 2000).

As seen through selected pieces of several of his speeches, Konaré is consistent in his support of innovation in the African favor and the importance of leaving the colonial structures behind. He reiterates the importance of African responsibility for African development and the need for action, and how this must be based on strong democratic principles. Konaré talks about IT as a medium and a tool for development, and has begun to make plans that involve resource commitments. Policies and financial backing are his next step to fulfilling his goals for Mali and Africa.

The Opinions of Advocates

Konaré's endorsement at the national and regional level is an integral prerequisite to action. However, advocates in the education sector are those catalyzing action and making the technologies applicable to the context. The perspectives of four of these advocates from different kinds of organizations (survey respondents) provide insight into

[20] A completed strategy in place for connecting Mali's 701 municipalities to the Internet (USAID, 2000a).

the feasibility of IT use in Mali and the conditions for its integration into the education system.

All respondents voiced their commitment to incorporating IT into the education system and confirmed that there is currently no policy for IT in education in Mali. And while the respondents indicated that policies need to be made and that this is the responsibility of the Ministry of Education, they have conflicting opinions as to whether policy will be instrumental in the success of having IT in schools—three say that this step is integral (Respondent Mali#1, Respondent Mali#2, and Respondent Mali#4), and one respondent talks about the problems with implementation of other education policies (Respondent Mali#3).

When talking about the process of wide-scale implementation of IT in schools, there is consensus that it will take time. One respondent (Respondent Mali#2) said that it will take as many as eight years to begin the process, another (Respondent Mali#4) said it would take a decade to see any change. Other respondents indicated that integrating IT into schools would be slow and that it would depend on the dedication of the people involved (Respondent Mali#1, Respondent Mali#3, and Respondent Mali#4). One respondent (Respondent Mali#1) noted that IT use would likely happen faster in higher education than in primary levels.

In any case, several respondents indicated that decision-makers would need to be sensitized to the importance and need for this technology in education, that actors at all levels would need to buy-in to this process, and that the appropriate expertise would need to be on-hand as well. A number of other factors were cited as prerequisites to this implementation, including infrastructure (Respondent Mali#2), but the overarching problem was that the system was not providing the needed resources for schools to begin using IT. A suggested starting point indicated by two respondents (Respondent Mali#1 and Respondent Mali#4) was to create an IT curriculum, a first step to having classes taught on the subject.

Respondents talked about the importance of bringing IT into education in a number of ways: as an improvement to the quality of Mali's labor force and therefore as economic development, as a way to catch up to the scientific revolution that has taken place, as a democratizer, and as a way to improve the quality of and access to education. The respondents clearly have a vision of how IT will contribute to Mali's development, and integrating it into the education system is one of the steps needed to work towards this vision. At this point, the need seems to be broadening both intentions and resource allocation for IT.

Pilot Projects: IT in Education

While there are many starting places, pilot projects have begun in spite of the lack of policy, with resources from a variety of places including the Malian government. In some cases, these projects are run by the advocates that responded to the survey for this study. Regardless of who they are supported by, the projects answer needs and demonstrate what is feasible, both important as IT use becomes more widespread and the government gets closer to supporting it through the education system. The projects currently being undertaken promote technical development and/or the use of IT.

- The University of Mali is installing a wireless network for all 13 of its institutes around Bamako, funded by USAID. In May 1999, a number of professors and students attended a week-long training-of-trainers to develop their Internet training skills in preparation for this connection.

- The University's connection will also provide Internet access to the MOE at all levels, countrywide, including the CAPs.

- The MOE and several private initiatives are piloting the use of IT in secondary schools, ensuring that the principals and Ministry officials are trained and closely involved in the projects' implementation (Respondent Mali#2).

- The Malian chapter of the Internet Society encourages students' use of the Internet by providing them with periodic workshops.

- Internet service providers with public access centers have discounted hourly rates for students to encourage them to use their IT services.

- The Pathfinder Foundation, established by Malian NASA engineer Cheick Modibo Diarra, inaugurated a multi-purpose center on July 4, 2000. The purpose of the center is to promote indigenous science, science education, and innovative

entrepreneurship in Mali and in Africa. In August 2000, the center provided training for 30 women engineers from secondary schools in 10 West African countries. Included in the center's projected activities is training for science teachers on practical approaches to teaching science and on Internet use and its relevance to science.

- The GLOBE Program—Global Learning and Observations to Benefit the Environment, a U.S. Government-sponsored program—is "a worldwide network of students, teachers, and scientists working together to study and understand the global environment" (from the GLOBE homepage at http://www.globe.gov). While the Internet is not a required tool, it can be used to submit data and interact with members of the GLOBE network. More than 8,500 students from 85 countries are active in the GLOBE program; Mali joined in 1998, and one GLOBE school in Bamako runs a multimedia center for students (Respondent Mali#3).

These activities, though not a comprehensive list, show that a number of organizations are actively promoting Internet use in education. Though, with the exception of the University of Mali (which is not yet operational), these are not system-wide applications, but the pilot programs do build awareness and test approaches that are a necessary foundation to larger-scale projects. The actors in these projects include the MOE, associations, and international organizations and aid donors.

In Mali, much of the groundwork is in place for a broader exploration of IT use in education. Endorsement from Konaré accompanied by forward-thinking advocates that include private organizations, international organizations, and the Malian government are all experimenting with IT to fulfill perceived needs. It is wise to approach longer-term and broader-based plans after gaining an understanding of the implications of these kinds of activities. Though the activities are still small-scale, the vision of IT's potential can be a guide to expansion.

Ghana

As in Mali, the education system in Ghana is based on its colonial legacy. A 1996 assessment of basic education cites many of the same systemic ailments: poor teaching and learning outcomes, inadequate access to education services, weak management capacity at all levels of the system, and unsatisfactory financing arrangements (Government of Ghana, 1996). While not as extreme as Mali, evidence of these problems is apparent as large numbers of students are not enrolled in school. Only 80 percent of school-aged children are enrolled in primary school and only 75 percent of school-aged girls. Enrollment rates in rural areas are even lower and continue to drop (Government of Ghana, 1999). While on average each teacher has approximately 30 students in his or her classroom,[21] a manageable number compared to Malian teachers who handle 70, inadequate pre-service and in-service training leaves teacher ill-prepared for following ambitious curricula. (Government of Ghana, 1996, p. 6). In addition, short class time and high teacher absenteeism make learning difficult and inconsistent. With all of these challenges, in addition to a shortage of materials and equipment, it is not surprising that teacher morale is low (Organization of African Unity, 1999).

Higher education acts as a filter in Ghana as well. Of those graduating from Junior Secondary School (JSS), only 30 percent continue on to Senior Secondary School (SSS), 20 percent of which attend vocational schools. Of the SSS graduates, ten percent attend university. The MOE acknowledges the larger problem caused by this lack of retention: "Like the JSS graduates, the remaining 90% of SSS graduates enter into the professional world ill-equipped and inadequately prepared for any specific employment" (Government of Ghana, 2000).

An Introduction to the Education System

Ghana's education system, though influenced by the colonial systems, was based on the schools established by churches that have a much longer legacy in Ghana than colonial

[21] Unless otherwise noted, the data in this paragraph is from UNESCO's 1999 Yearbook. Please see the note about the data on page vii.

governments (Dwomoh, 1995). However, the Ghanaian system is by nature participatory as Evans (1994) suggests of those influenced by Anglophone structures. Many kinds of organizations play a role in education policy-making: other ministries, experts, several teachers and students associations, staff associations, publishers' associations, the association of private schools, religious education units, international donors, and NGOs (Respondent Ghana#4). The Ministry of Education manages this process, but the Ghana Education Service is the branch of the state education system that handles 80 percent of the functions required for implementing pre-university level policies. The structure is organized with a director for each of the ten regions, and a District Education Officer for each of the 110 districts (Dwomoh, 1995). The central government pays all salaries and determines curriculum for all pre-university institutions.

Education and Vision 2020: The Current Plan

In the late 1970s and early 1980s, an economic decline spurred an exodus of teachers to neighboring countries where wages were higher. As a result, the quality of education declined rapidly. Student teachers were recruited to fill the positions, but the system itself needed attention. After receiving support from international aid donors, including the adoption of a structural adjustment program through the World Bank, the Ministry of Education took control of the education sector and defined its own priorities in 1994. This initiated the birth of FCUBE, Free Compulsory Universal Basic Education, basic education reform spanning from 1996 through 2005. The 1992 Constitution had made free basic education a universal right, and this plan aimed at addressing the challenge. Parliament mandated that this program be the only program through which resources are delivered to basic education in Ghana, thus streamlining the process and keeping control with the MOE. This institutionalization of aid coordination has proved to be efficient but required strong leadership.

Encompassing FCUBE is the most recent and comprehensive reform undertaken by the government: Vision 2020. This plan is designed to bring Ghana to middle-income status by the year 2020 by reducing poverty, increasing employment opportunities and Ghanaians' average incomes, and reducing inequities to improve the general welfare and

material well-being of all Ghanaians. This vision highlights intersectorality and a holistic perspective on reform (McGrath, 1997). The education portion contributes by planning for:

- basic education for all,
- education and training for skill development, with an emphasis on science, technology, and creativity,
- expansion of higher education, and
- facilities to make sure all citizens are literate and self-reliant (Government of Ghana, 1999).

In the short-term, plans for Vision 2020 look much like Mali's PRODEC by outlining the actions for all parts of the MOE and the education system: improving the quality of teaching and learning, increasing access and participation in the formal education system, improving the efficiency of management, and decentralizing the educational administration. And, like Mali, Vision 2020 is heavily reliant on donor funding. Ghana takes their education plans a step, further, however, by including the provision of facilities for all citizens to become literate and strategies to make education responsive to the manpower needs of the country—including a focus on training in science and technology (Government of Ghana, 1999). These goals will be achieved through four main programs:

Free Compulsory Universal Basic Education (FCUBE): FCUBE is designed to provide every child with a good quality education, improve the teaching process and learning outcomes, strengthen management of the basic education system, and improve access to education—especially for girls and disadvantaged segments of population. This program consists of four components: curriculum and learning, strengthening management to improve efficiency, access and participation, and cost and financing with the view to sustainability (Government of Ghana, 1996). FCUBE reinforces many earlier reforms and encourages private sector participation in the provision of educational facilities.

FCUBE is already seeing some results: in-service teacher training has increased, being delivered both at the district and school levels; teacher-community relationships have

improved; and almost every student in basic schools has an English and a mathematics textbook.

School Performance Appraisal Meeting (SPAM): Another of FCUBE's outcomes is that all basic schools (pre-SSS) are now owned by the communities; the MOE declared that school management and supervision is no longer their sole responsibility, but that of the communities as well. The SPAM is the mechanism for the MOE to keep communities informed of their schools' performance and to encourage them to participate in maintaining a high-quality education. Because of the successes that the SPAM have achieved thus far in getting communities involved in their schools, the Ministry of Education may expand the program to Senior Secondary Schools (Essah-Hienno, 2000).

National Functional Literacy Programme (NFLP): NFLP is a continuation of previous efforts to identify target populations to help them read, write, and compute in one of the 15 local languages. In addition, it will develop efficient management aimed at strengthening linkages with NGOs and other organizations involved in non-formal education.

Development Programme in post-Basic Education: At this time, feasibility studies are still being conducted to determine higher education needs. Aspects being considered are enrollment rates, curricula, teacher quality and availability, capacity of technical institutes, and financing. In the meantime, in an effort to make higher education more accessible and to alleviate some of the pressure on institutions to provide services for a high demand, the MOE approved distance education programs in 1996. Little else has been mentioned about these programs, implying that they have not been realized (Fillip, 2000). The feasibility studies will also examine how well the structure of the university programs is coordinated with the demand in the labor market (Government of Ghana, 1999).

The importance of the need for building scientific and technical skills to contribute to Ghana's economy is an important feature of this post-basic education study. The

"technical proficiency of the Ghanaian labor force" is being implemented through NACVET (The National Council of Technical and Vocational Training) and focuses not only on training, but also on creating new partnerships with the private sector for their participation in and funding of these trainings (McGrath, 1997; Respondent Ghana#4). This approach also encourages the needed link between education and employment opportunities.

While these programs are underway, the Government of Ghana continues to support the participatory spirit of the education system. In November 1999, a three-day National Education Forum was convened in Accra to bringing together a wide range of stakeholders in education. More than 500 people attended "to discuss and review the progress of education since the reforms of the late 1980s, and to consider the way forward" (Government of Ghana, 2000). As a result, a number of resolutions were drafted and being reviewed by the MOE for future policy consideration.

The Telecommunications Sector[22]

In the mid-1990s, Ghana had a total of 77,900 main lines for its 17.83 million people—roughly 3 for every 700 people. Like Mali, though to a lesser extreme, the distribution of the telephone lines was heavily skewed in favor of urban areas, where 36.3 percent of the population used 82.9 percent of the lines. In 1996, there was a waiting list of 28,300 requests for phone lines, with an average wait of 2.9 years. The quality of existing lines was poor, 112 faults were reported for every 100 lines. There were .03 public telephones for every 1,000 people.

Ghana Telecom had a monopoly of telecommunications services until January 1998 when the second network operator was awarded privileges to provide domestic and international telecommunications services. This and other reforms are a result of government policies aimed at meeting the country's telecommunication needs and at having a positive impact on Ghana's economy. The liberal policies that make up these reforms, titled the Accelerated Development Plan (ADP), encourage private sector

[22] Data is from the International Telecommunications Union from 1996, unless otherwise noted.

involvement and geographic expansion of infrastructure. As a result, up to 500,000 new telephone lines will be installed countrywide and the retention of regulatory control of the sector through the National Communications Authority, thereby looking out for the interests of the country and all of its stakeholders in this sector (Government of Ghana, 2000a).

Even prior to the reforms, telecommunications costs were more affordable for Ghanaians than they are for Malians. Based on a GDP per capita of $362.00 (1995 data), annual residential subscription fees for a telephone line cost 2.8 percent of the GDP per capita. A three-minute call in the same area cost only an additional 8 cents. Currently, monthly subscriptions for Internet access average $30.00; Ghana's four Internet service providers serve 8,000 accounts[23] throughout the country and have seven POPs for easy access from the secondary cities. Now with two national network operators, the situation is likely to continue to improve.

About IT for Education

As mentioned above, Ghana's Vision 2020 emphasizes technology skill development—a critical first step in providing indigenous training capacity for IT. There are a number of elements in place that show support for IT in education: the policy environment is conducive; public discourse emphasizes its importance; advocates—unlike those in Mali—appear to be satisfied with the policy-making process; and a number of established activities use and build awareness of IT in education.

Policies

Policy-makers in Ghana have been planning for IT use. A comprehensive communication policy was recently instituted by the Ministry of Communications, based on input from a national conference two years ago (Respondent Ghana#1). In this spirit, the education sector is drafting a policy specific to their sector reforms, FCUBE has already included computer training as a part of its management strengthening activities,

[23] This number indicates the number of accounts; the number of users varies for each account but can be, for example, all of the employees of an organization.

helping the MOE to manage their information better and giving them an appreciation for the utility of information management tools.

In addition, the Accra office of the West Africa Examinations Council has instituted curriculum for teaching IT applications at the Senior Secondary School level. Classes include basic word processing and spreadsheet use as well as basic technical skills for creating networks and troubleshooting. The aim of the classes is to provide "an understanding of Information Technology Principles and their applications in both the Private and Public Sectors of the Economy, and solving problems through analysis and synthesis" (West Africa Examinations Council, 2000). These applications show that IT is being used when and where applicable, and in a variety of ways, to improve Ghana's education system.

Voicing Continued Support

Ghana's new education reforms demonstrate the country's support for technology, and are clearly an indication of the leaders' support especially as they are integrated into Vision 2020, which itself outlines the country's long-term development strategy. On July 30th of this year, at the inauguration of a technology center, NEKO TECH, Ghanaian President Jerry Rawlings took the opportunity again to emphasize the need for technology in Ghana's development.

> [President Rawlings] stressed the need for Africa to acquire the technical skills required for the computer age in "the global village." [...] He said Ghana must strategically position itself to maximize the benefits of technological advancement. President Rawlings said the government would support projects such as the NEKO TECH to ensure that the country has the requisite manpower. [...] This would enable the country to meet the targets of the Vision 2020 document (http://ghanaclassifieds.com/news/headlines/936.html).

Another supporter of technology education is Nii Quaynor, the chairman of Ghana's oldest and largest Internet service provider, Network Computer Systems (NCS). Quaynor is optimistic about Ghana's potential IT growth if Rawling's government continues to make technical education a priority.

> The limiting factor is human resource capability. If we increase that, growth might be 100 percent or even 300 percent." He goes on talk to the need for IT for development and what it will take for Ghana to be a leader in the region. "Our motive is not business, but a social cause to make sure that the country has IT and Internet services. [...] If Ghana is to be the Singapore of Africa, I need the people trained at all levels. Not 5,000 or 500, but a million a year. That is my mission, and that is why I am here (Botje, 1999).

Though framed in a global context, Rawlings and Quaynor (in this discourse) talk more about what is needed to achieve their visions than defining the visions themselves. The need to grow human capacity to use and develop IT is more specific than Konaré's push for taking responsibility. While both are empowering their people in their rhetoric, Ghana seemingly is now concerned with what needs to happen internally, not what needs to be said to the world.

The Opinions of Selected Advocates

Responses to the survey confirm that Ghana has been moving towards IT policies over the last several years. In fact, a draft policy on IT framed existing pilot activities and the establishment of Science Resource Centers in each of the 110 districts (Respondent Ghana#3).[24]

The respondents, who were affiliated with different types of organizations, have faith in the policy-making process—in spite of the politics that often sway the process—but also talked of the value of private sector participation in encouraging IT in education (Respondent Ghana#2, Respondent Ghana#4). They all asserted that IT was the tool needed for Ghana to develop quickly—one person said this was the only way for Ghana to catch up to the rest of the world (Respondent Ghana#1). Several respondents mentioned the Vision 2020's plan to build the labor force and reiterated that policy has a role in systemic change. Ghanaian schools are waiting for the system to provide them with the resources and guidance to begin using IT for change. The respondents have

[24] These centers are supported by the MOE; they include a science laboratory furnished with modern equipment and one computer with an Internet connection.

dramatically different views about how long the government would take to accomplish this—some are very optimistic, and some are not.

In spite of the differing policy situation with education and IT, Ghanaian advocates have similar visions to Malians—optimistic and general. This is likely because IT activities have not yet become widespread, and their full potential has not been explored. Once this happens, advocates and others involved will likely be able to talk in detail about the innovative applications of IT to African education and for African development.

Pilot Projects: IT in Education

Like Mali, pilot projects were initiated before policies were in place. And, like Mali, international donors have begun investing in IT activities in Ghana. However, a number of Ghanaian organizations have also been formed to promote IT activities. Described below are selected projects that reflect the kinds of organizations involved and the nature of the projects undertaken.

- The World Bank's World Links for Development Program (WorLD) began training teachers and installing computers and Internet connections in selected Ghanaian schools in 1997. Since then, the number of partner schools has increased to 14, and the program has raised $30,000 from the Ghanaian private sector for further expansion. Students' projects include a variety of subjects that allow them to learn about and collaborate with other students around the globe and to become sensitized to economic, political, and social issues.

- Partners for Internet in Education (PIE) was formed in 1997 with the assistance of USAID's Leland Initiative and became a registered Ghanaian association in March 1998. PIE was formed to build awareness and advocate for the use of Internet in education, and it acts as a forum for schools and individuals to share ideas and initiate projects. In 1999, PIE was awarded funding from USAID/Ghana to establish a Community Learning Center in the National Library in Accra, to provide Internet access and support to the public, especially students. PIE still acts as a catalyst for other projects, including a cultural anthology of a historical Ghanaian community on CD-ROM and the development of software to teach others about Ghanaian culture.

- Mentioned above, Science Resource Centers have been established in selected Senior Secondary Schools in each of Ghana's 110 districts to supplement existing science laboratories (if any). Their goal is to give Ghanaian students access to modern equipment; these centers included one computer with an Internet

connection (where possible). Acknowledged and supported by the MOE, these centers are the one example of a systemic intervention that includes IT, though the effectiveness of these centers has yet to be determined (Anamuah-Mensah, 1998).

- Ghanaian universities have begun to pay attention to information technologies. The University of Science and Technology (UST) in Kumasi has begun a Centre for Distance Education and one program: a B.S. in Building Technology. The University of Cape Coast also has a Department of Distance Learning, and the University College of Distance Education at Winneba has been established. The University of Ghana at Legon, too, has a computer center for students and teachers.

- The Ghana Association of Computer Learning and Distance Education (GHACLAD) is a nonprofit organization located in Illinois created to build awareness of how IT can address current educational challenges. GHACLAD hosts a annual conference in Accra to bring together people worldwide working with IT in education in Ghana.

- The GLOBE Program is also active in Ghana, with 35 participating schools.

- Network Computer Systems (NCS), the largest ISP in Ghana, offers free Internet subscriptions to all schools in Ghana.

- In addition to the above projects, a number of Ghanaian schools have their own Internet connections, and many of those have created their own web sites.

These activities demonstrate that a number of actors are involved in IT and education including an international donor, a Ghanaian NGO, the MOE, an international organization, and individual schools. Some activities are several years old; they range from training and project development, to advocacy and the dissemination of lessons learned. The extent to which these projects and programs have developed indicates that these activities have been evolving for some time in Ghana. Again, like Mali, these activities will act as a reference and a springboard for the new activities to be put in place by new policies.

Comparing Mali and Ghana in Broad Strokes

The following synthesis consolidates the information in the case studies, and provides a comparison between Mali and Ghana. This allows the reader to frame the information before proceeding the following section where an analysis is provided using the five conditions that depict the resources and intentions extant in the system.

Comparing Current Contexts

In both Mali and Ghana, colonial legacies are still clearly visible through the design and processes of their education systems. While these systems were originally established to serve the needs of the government, first colonial then independent, they have been steadily moving towards providing education for all citizens. Enrollments have been steadily increasing over time, but both Mali and Ghana are still plagued by systems that do not meet the needs of all of their people—schooling is not accessible to many, repetition rates are high, promotion rates are low, and there are shortages of teachers, classrooms, and materials. In addition, higher education is not aligned with the countries' economic goals. Both countries have systems that are still highly centralized, and both are in the process of decentralization.

Current education reforms in Mali and Ghana are similar, though there are several striking differences. Mali and Ghana are both striving to educate all of their people and are tackling all levels of education to do so. They are calling on everyone—all stakeholders in education—to assist in the process. Both countries' reforms specifically plan to meet needs in teacher training, increase access to schooling, and improve management of the system. The primary difference is where the emphasis lies in education reform in each country. In Mali, elaborate plans have been drawn to make the education system capable of providing the broadest possible audience with basic education. Plans include creating partnerships and communication, empowering communities, encouraging local language instruction, and developing a system for providing materials. In Mali, plans for higher education address keeping costs down and making the content applicable to the country's economy. Ghana's education plan is

integrated into a larger national strategy for development, Vision 2020. Though it gives attention to primary education, Vision 2020 calls for expanding higher education and encouraging skill development and creativity in science and technology—potentially strategizing for the future economy, per Canning (1999). In short, using the categories set forth earlier by Plomp et al. (1997), on a systemic level, Mali is beginning to incorporate IT as an aspect of education, while Ghana is beginning to understand it as a medium. Mali has incorporated IT into education in developing skills for using it in specific ways. In Ghana, IT is being used to learn and to be innovative in developing new skills and applications, suggesting that Ghana is currently able to take fuller advantage of what these technologies offer.

In terms of telecommunications infrastructure, both countries have vast disparities between urban and rural areas. To its credit, Mali has installed a domestic satellite system to ameliorate availability and quality of access outside of Bamako; Ghana's privatization has had a similar effect by bringing in another operator. These services are much more affordable to Ghanaians however, as local telephone calls cost half of what they do in Mali, and annual subscriptions are almost seven times less affordable for Malians. This may be due in part to the privatization of the Ghanaian operations, as countries that have undergone privatization have seen extensive improvement in the quality of telecommunications services and a decrease in their prices (Spiller & Cardilli and Waverman & Sirel as cited in Canning, 1999).

The Internet is also accessible countrywide in both Mali and Ghana, though in Ghana it is due to infrastructure while in Mali it is due to policy. Mali has the lowest costs for ISP access (wholesale from the telecommunications operator) in the region and has five ISPs. Ghana has four but provides access to eight times the number of subscribers. There is clearly more demand in Ghana, perhaps because their Internet industry began in 1992, four years before it began in Mali.

This table provides an overview of education and telecommunications data, for comparison:

Indicator	Mali	Ghana	USA[25]
Population (ITU)(1996)	11.13 million	17.83 million	266.56 million
GDP per capita (ITU) (1995)	$238	$362	$27,569
Education (UNESCO data unless otherwise noted)			
Gross enrollment	Primary: 41 percent Secondary: 11 percent Tertiary: 1 percent (1994/5)	Primary: 79 percent Secondary: No data Tertiary: No data (1994)	
Primary school intake rate	42 percent (1995)	No data	
Repeaters	18 percent (1995)	No data	
Teacher-pupil ratio	1:70 (World Bank 1999, 1996 data)	1:30 (1994/5)	
Promotion to secondary school	25 percent (1995) find better number	30 percent (Government of Ghana, 2000; no date for data)	
Telecommunications (ITU data)			
Total main telephone lines (1996)	21,300	77,900	170,568,200
Main telephone lines per 100 people (1996)	.19	.44	63.99
Wait list for telephone lines (1996)	No data	28,300	None
Waiting time for telephone lines (1996)	No data	2.9 years	None (years)
Faults per 100 main lines per year (1996)	No data	112	4.4
Public phones per 1000 people (1996)	.05	.03	.97
Urban percentage of population – percentage of phone lines (1995)	Population: 26.9 percent Phone lines: 96.5 percent	Population: 36.3 percent Phone lines: 82.9 percent	
Rural percentage of population – percentage of phone lines (1995)	Population: 73.1 percent Phone lines: 3.5 percent	Population: 63.7 percent Phone lines: 17.1 percent	
Cost of 3-minute local call (1996)	$.17	$.08	$.09
Annual telephone line subscription as a percentage of GDP per capita (1995)	19.1 percent	2.8 percent	.5 percent

Table 2. Selected Indicators, Mali and Ghana.

[25] USA figures are included to show comparison for better comprehension of the implications of some indicators.

About the Discourse

In spite of the differences in the state of education and telecommunications systems in Mali and Ghana and in the progress that each country has made towards integrating the two systems, discourse from the leadership is remarkably similar. Both leaders talk about the need to participate in global systems and to develop the human capacity to maximize that participation. Konaré puts a specific emphasis on the role of democracy, the need for innovation, and Africans' responsibility for their own development. Rawlings focuses in on Ghana's need to develop the necessary human capacity. So while both leaders may have gotten their cues from the what is being discussed in the "international systems", Rawlings seems closer to having his strategy in place.

When surveying other advocates in the promotion of IT in education, a number of familiar themes surfaced. The survey (included in Annex 2) asked participants to describe the process of educational policy-making in their countries, their thoughts about how policies for IT would evolve within the system, and their feelings about the need for IT in education. A notable observation about the responses categorized in the theme table (see Table 3) is that Ghanaians all expressed faith in the policy process in Ghana. Malian respondents did not show this kind of faith in the process but rather expressed the need to build awareness among decision-makers. No matter what the opinion about the policy process, everyone agreed that it was necessary in providing a framework for future action. So, in spite of the presence of successful pilot activities, there is consensus that the government must provide the enabling environment for expansion. It is not until the government has set forth the framework that other kinds of support (i.e., the private sector) can begin to define their role.

Most respondents outlined some next steps. A Ghanaian suggested that the private sector participate in supporting IT activities. On the other hand, when Malians talked about needs, they noted many of the prerequisites to these reforms (infrastructure, awareness, training). They were also concerned that the process for integrating IT into the education system will take time, whereas Ghanaians were not universal in thinking that time would be a significant impediment in implementation. There seems to be a chronology for the

steps that can be taken, beginning with government support, policies with resource allocations, and then the freedom to build from there. Advocates give little mention to the significance of the pilot activities and their role in this continuum.

Theme	Mali	Ghana
About the policy process	Conflicting opinions about whether policy will be useful to the process	Faith in policy process, in general. Politics play a significant role.
Primary barrier	Resources for schools, not being provided by the system	Resources for schools, not being provided by the system
Actions needed	Need to build awareness among decision-makers	Need private sector participation
	Develop IT curriculum, levy taxes	
	Prerequisite conditions: resources, infrastructure	
Time needed	It will take time	Conflicting ideas about how much time it will take
Potential of IT in education	Improve labor force	Build labor force
	Help catch-up to the rest of the world, develop country	Help Ghana develop quickly, the only way
	Improve quality and access to education	
	Democratizer	

Table 3. Themes: Advocates Survey Responses for Mali and Ghana

In spite of the differences between Malian and Ghanaian educational goals and the feasibility of systemic IT integration, the survey respondents had answers similar to those of the leaders about the potential that IT holds: the need to develop the human capacity to catch up the rest of the world. Interestingly, one Malian respondent cites the need for IT to promote democratization, a common theme for President Konaré.

IT Activities in Education

Though the list of IT activities education in Mali and Ghana is not comprehensive, they reflect a number of similarities in what types of organizations are involved in the promotion of IT. International aid donors, associations, schools, and international organizations are involved in isolated activities and, in some cases, larger-scale advocacy efforts. In both countries, the Ministries of Education have begun large-scale projects. In

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Ghana, at least two organizations (GHACLAD and PIE) were created specifically to promote the use of IT in education.

In Mali and Ghana, like Means et al. (1993) said for the United States, the kinds of activities undertaken all attempt to achieve better education and learning. In both countries, there is an array of audiences (students, teachers, administrators) and a range of approaches (projects, skills, training, and access). Both countries have public centers available to students at discounted rates, and both countries have programs that are particularly conscious of the need to tailor and maximize IT to Malian and Ghanaian needs.

So though Ghana has more policies in place to facilitate IT use and encourage the system to put resources into IT on a broad scale, both countries have sources of encouragement and are developing a basis for using IT in schools. The analysis in the following section will explicate the similarities and differences between countries, and elaborate on how each of these attributes contributes to the countries' ability to harness IT.

The Analysis: Mali, Ghana, and the Five Conditions

With Mali and Ghana fresh in mind, this analysis will revisit the five conditions of integrating IT into education systems: awareness, access, applicability, African adaptation, and advocates. The first three conditions capture the resources available, while the last two describe the intent of the system. The information set forth above about Mali and Ghana will be categorized into those five conditions below, thus in summation evaluating the countries' abilities to harness the potential of IT.

Awareness

Awareness is divided into three indicators: awareness of the potential of IT in education, mechanisms in place to promote that awareness, and the structural elements that show how conducive the environment would be to future awareness building. In this way, both the current situation and the potential one are included.

Ideally, awareness would be measured at all levels of education stakeholders by conducting a national poll. Mechanisms and structure would be best evaluated in a longitudinal study, after a successful awareness building campaign. Instead, this study considers the factors that make the current environment a viable one for awareness building. (See Table 4, Annex 3 for details.)

Awareness of the Potential of IT in Education

The presidents of both Mali and Ghana are aware and vocal about the potential of IT in education, as are a number of advocates. These advocates are aware of the challenges and have ideas for next steps. In addition, there are organizations that are implementing IT activities in education. The variety of types of implementing organizations indicates that there is both international and domestic support for these activities.

Mechanisms for Promoting Awareness

The publicity surrounding the activities in place is one of the best mechanisms for promoting awareness of the feasibility and potential of IT for education, because it is

based on actual experience. In addition, there are organizations in both countries that have in their mandate building awareness of IT in education (in Mali: The Pathfinder Foundation, The Internet Society; in Ghana: PIE, GHACLAD, the Science Resource Centers, GLOBE). It is possible, too, that advocates will play a role in building the strategic awareness necessary to promote the next steps they deem necessary.

Conducive Structure

The literature about both Mali and Ghana describe the participatory nature of the systems and the governments' willingness to bring stakeholders into discussions about education reform. Evidence of this is Ghana's 1999 National Education Forum and the National Debate and Conference on Education in Mali in 1991. The process that Mali used in creating PRODEC, too, demonstrated the government's commitment to widespread participation.

Structurally, the Malian Ministry of Education—through PRODEC—plans to decentralize to the district level with the CAPs; Ghana already has this level of mechanism through the GES and their education implementation to the 110 districts. In addition, the Ministries have encouraged communication between all levels of the administration, including the communities that have taken on school management—in Mali through PRODEC's communication strategy and in Ghana with SPAM. And, telecommunications infrastructure is available and expanding for future IT demand.

Access

Like awareness building, access is multi-tiered. Access to IT through education requires both access to IT and access to education. (See Table 5, Annex 3 for details.) Again, while there are more thorough methods for measuring access, the evidence included is limited to information available in the scope of this study.

Access to IT

Neither Mali nor Ghana have policies in place that specifically promote IT in education. However, Ghana has a number of policies that create a larger, catalytic context. Not only

does the Vision 2020 set the stage for channeling resources and attention to building technical skills, but there already exist policies that acknowledge and support IT curriculum and distance education. In Mali, there are no policies to support or provide resources for IT in education, but there are a few systemic activities that are leading the way.

The resources available for accessing IT for education purposes in Mali and Ghana are similar. Hardware and software are expensive and limited in their availability, as is technical assistance to support IT. The telecommunications infrastructure allows for access countrywide in Mali and Ghana, though it is very limited in rural areas and is more affordable and more used for Internet in Ghana. Another advantage of Ghanaian schools is the free Internet subscriptions provided by NCS, the largest ISP in Ghana.

Universities in both countries are becoming connected and developing expertise in IT, though in Ghana it is being used as more of a learning tool than in Mali. Universities therefore provide access to information technologies, as do telecenters and other public access centers that are available to students and teachers. Small-scale activities in both countries provide access to the audiences they target.

Access to Education

As described above, the limited access to education is one of the biggest problems in Mali and Ghana. Both countries' ten-year plans promise to increase access to education by expanding capacity, enrollment, and retention. In addition, as previously mentioned, communities are given more responsibility for their schools in an attempt to improve quality and availability of education. Ghana is also planning on expanding its ability to provide higher education.

Applicability

The applicability of IT to education is measured by evidence that indicates applicability and mechanisms that can potentially make IT applicable. (See Table 6, Annex 3 for details.) The former include the policies and activities, both small-scale and system level,

that outline and demonstrate where in the system IT should be used. In Mali and Ghana, these exist systemically in the higher education and in a variety of small-scale activities for all levels of education. These small-scale activities have the advantage of flexibility and the important role of experimenting with applicability and relevance of content and context. Overall, Ghana has more finalized mechanisms in place instituting IT integration at the systems level: complementary and catalyzing policies, and curriculum. In addition, as a part of FCUBE, Ghana has integrated computer use into the administration.

Teachers are the most important mechanisms for applying IT to education. Without teachers' endorsement and active support of IT, it cannot become an effective classroom tool. Unfortunately, and in spite of the teacher education that is planned in both countries' reforms, there is little support for their use and promotion of these technologies among teachers. As far as the documents describe, there is no IT component in either pre-service or in-service training. Teacher availability is strained, their classes are too large, they are working without the necessary materials, and in Ghana, they do not have enough class time. It is no wonder that teacher morale is low, and it would be unlikely that teachers would invest in new tools (i.e., IT) under these circumstances.

There is one last application worth mentioning. One of the promises of information technology in these environments—and one that often makes the investments worthwhile—is the ability to access information and communicate in ways that can overcome many of the constraints that face education. Especially in the case where textbooks and resources for lesson plan ideas are few, the Internet can give new energy to education.

African Adaptability

When considering the ability of IT to be leveraged for African benefit through the education system, the system must be evaluated in terms of its ability to have that interest. (See Table 7, Annex 3 for details.) The literature says that the systems are still reflective of their colonial legacies. However, the goals of Ghana's Vision 2020 indicate

through a focus on higher education and building technical skills that this may no longer be the case. Mali's policies continue to focus on access to basic education but do talk about linkages to the economy at secondary levels.

One indication that the systems might be changing is the steps being taken to make education relevant: giving communities control of the schools and changing language of instruction to encourage participation.[26] These are both happening in Mali and Ghana. Other signs of adapting IT to African needs are, as mentioned, the activities undertaken by several of the pilot programs and, in Ghana, the privatization of the telecommunications services—with a focus on encouraging private Ghanaian ownership of services.

Finally, regardless of how unrealistic IT may seem in some places in Mali and Ghana, their leaders continue to explain publicly how and why IT is important to their countries' and their continent's development.

Advocates

In this study, a number of advocates for IT in education were found in both Mali and Ghana. (See Table 8, Annex 3 for details.) Public discourse made by both presidents indicates a high level of awareness to using technology for development, and Ghana has the policies in place to support those statements. In addition, there are advocates involved in encouraging IT use in education at a number of levels (policy, implementation through pilots, both). If this study had a broader scope, it would use the snowball sampling method to identify and map (per organization) as many of the advocates as possible to understand where the key catalysts are and to begin to predict how and where change will happen.

[26] This is controversial, and much has been written about it. For information about the importance of language of instruction, see for example Ndoye, 1997.

The Bottom Line: Resources and Intent

There are a number of resources already in place that are inspiring IT use in education: endorsements from leaders, energy from advocates, and small-scale activities to act as awareness builders and models. There are also those resources that will soon be able to support these efforts, including telecommunications access, policies for integrating IT in education, and availability of in-country technical assistance. Unfortunately, it will take time before hardware and software will be affordable, as there is no African capability to manufacture them at low enough costs to make them widely available.

The education system itself will likely not undergo changes fast enough to be responsible for implementing IT to its best advantage, as programs are still trying to improve access, quality, and distribution of simpler materials. However, the emphasis on building two-way communication with all stakeholders is conducive to future awareness building and activity implementation.

The strongest evidence of the changing intent of the systems to those that promote African development and empowerment is what the leaders are saying and what the policies have outlined. There are also a few activities that are designed to harness the potential of IT for Mali and Ghana that should be watched as models for systemic change. Advocates' survey responses are testimony to the important role that advocates play at all levels of the system. The following table simplifies the analysis:

	Mali	Ghana
Education	Inadequate	More adequate
Telecommunications	Inadequate, possibly improving	Inadequate, improving
IT in education, systemically	As an object, as an aspect	As an object, as an aspect, as a medium
High-level awareness	External	External, internal
Advocates	Vision still generic	Vision still generic
Activities	Pilots: lots of actors, lots of approaches	Pilots: lots of actors, lots of approaches

Table 9. Simplification of Analysis, Mali and Ghana

As it stands now, all things considered, Ghana is more capable of being innovative than Mali, as it has begun to embrace IT as a medium for learning, rather than merely an aspect of it. This progress can be attributed partially to time and forward-thinking policies, but also an educational system that is better able to serve its population. In this way, some resources can be spent on visions instead of on creating the foundations on which to build the visions.

Conclusions

The education systems in Mali and Ghana are not yet ready to support broad-based implementation of IT activities, due to a lack of both resources and intent. In both countries, the systems are not able to serve the population (enrollment, materials, etc.) and are therefore far from being able to deliver IT to all classrooms. Furthermore, the intent of the systems themselves, slowly shifting from the colonial model, does not encourage the kind of flexibility, experimentation, and innovation that allows for maximizing what IT can bring to Mali and Ghana.

However, there are a number of essential ingredients in place that hint at pending readiness. The policy environments are changing and IT is beginning to appear in policy rhetoric, advocates for IT in education are aware of the next steps in pushing towards widespread use of IT, and a number of pilot projects in each country serve as models and catalysts to further IT applications in education. Because it appears that governments are relied upon to create the framework for widespread action, policies must be put in place as soon as possible. Resources tied to these policies are the next step, bearing in mind that the current disparities in the delivery of education will need to be compensated for. These resources will need to provide not only the equipment necessary, but awareness about the utility and importance of IT for education throughout the school community, and the time for teachers and students to learn how to use the tools in a manner that makes them worthwhile thereby allowing Africans to use IT in a manner consistent with their educational goals.

This is not a simple process, and the order in which things need to happen is not consistent or clear. There is a combination of enabling factors in both Mali and Ghana that can be used to push IT forward. However, the current problem is structural both in terms of resources and intentions. Until the education systems are able to deliver relevant education to the masses, the likelihood of delivering IT in a manner where the outcome is worth the investment—especially in places like Mali and Ghana where the investment is so costly—is slim. Furthermore, considerations outside education like

telecommunications access and cost, as well as hardware and software availability, should be taken into careful consideration in the planning stages of policy-making. Without this forethought, policy implementation could be stalled until other policies and accommodations are made.

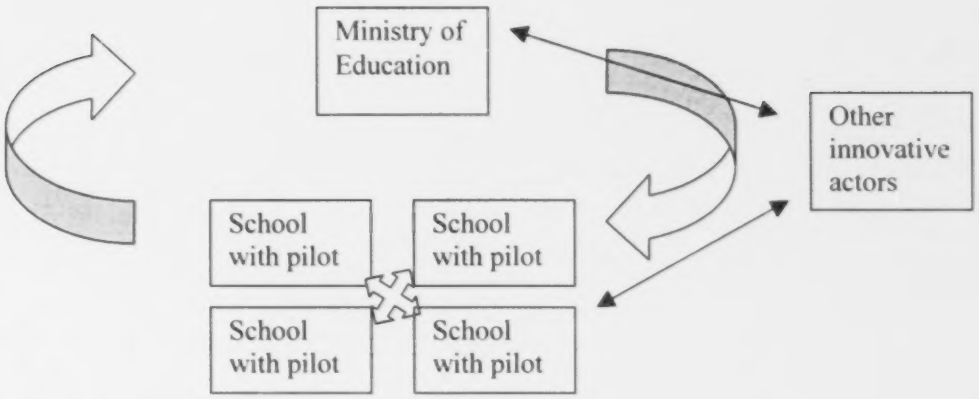
What these case studies show is that, in spite of the structural challenges and resource shortages, Mali and Ghana have in place some of the essentials in beginning to maximizing IT use in education: advocates, policies, and small-scale pilot activities. While these three things cannot make up for the larger issues, they can catalyze and demonstrate the relevance and utility of IT to African education, building awareness and encouraging new pilots, and preparing for the day when the systems are ready to harness IT.

Recommendations

Given the inability for Malian and Ghanaian education systems to harness IT at this time, an alternative approach is necessary for growing IT use in a way that benefits African development. The approach recommended draws from a number of lessons from the literature and from the author's experience.

Motsoaledi (1997) and Means et al. (1993) advocate for a combination of top-down and bottom-up approaches when encouraging IT use, and assert that the school be the unit of reform. Similarly, Byron & Gagliardi (1998) insist that the way to begin is with pilot activities. Means et al. (1993) make the case that the implementers, often few in number, need the support of the institution to be compelled to continue their efforts. Broad-based reform that accompanies the grassroots innovation is the best way to encourage this kind of applied IT use and make it sustainable.

The recommended model is based this study's findings, the literature, and the author's experience. By using the strength of the pilot activities in the context of the systemic weaknesses and incorporating the invaluable advocates, a model like the one suggested in the literature review by Moulton et al. (1999)—an organic one in which the changes grow from the needs—is created. It is top-down and bottom-up, and depends upon communication between decision-makers and implementers (a notion already being encouraged in both Mali and Ghana through current reforms). This model will allow education goals to drive the programs and for the resulting context-specific lessons to be fed back to the decision-makers. This will keep the approach innovative, feasible, and tailored to the education systems and goals in place. See Figure 1 below.



(All arrows indicate communication)

Figure 1. Schematic of the Recommended Model for Maximizing Pilot Activities

According to this model, selected schools with pilot programs will be given additional resources and guidance from the Ministry of Education and other innovative actors, and asked to experiment with information technologies to find the best ways to achieve relevant learning results. The emphasis is on tailoring the use to the overarching MOE goals and to their manifestations in the classroom context in Mali, Ghana, or other countries. Resulting ideas and applications are then shared with the MOE and other actors, and are compiled and built upon to continue growing relevant learning resources. In addition, participating schools are encouraged to collaborate and share ideas. The number of pilot schools grows based on the MOE's ability to provide resources and guidance, and the schools' ability to use IT in the innovative and experimental manner that this model requires.

This model is elitist targeting only those who are already at an advantage for IT use, so every effort should be made to expand access within the pilot activities (i.e., host awareness building activities, develop partnerships with less fortunate schools to provide them access and ideas). But by using this elitist approach, further implementation of IT

activities can be done efficiently and successfully so that lessons need not be re-learned and so that frustrations can be avoided. With any new tool, if participants are frustrated and cannot make it perform as promised, they will likely abandon it and will not be inclined to try again in spite of others' good experiences. Given all of the conditions that need to be favorable (outlined in this study), this model is ideal for minimizing the chance of frustrating experiences and rather aims to make IT use a positive experience that encourages experimentation and innovation at policy-making and grassroots levels.

This model would be particularly effective in Mali and Ghana at this time, building from the ingredients in place and helping to grow those that are still scattered.

Areas for Future Research

This study raises a number of questions, makes several assumptions, and points to a number of areas for further research. These include:

- A study of how new telecommunications technologies are improving rural access to the Internet
- A study of how radio and other lower-end communication technologies can be used to disseminate information from the Internet
- An examination of leaders' discourse and its role in catalyzing IT use
- An analysis of IT policies for education in Mali and Ghana, once they are instituted, within the context of this study
- A study of the role of the private sector in promoting IT use in education in Mali and Ghana
- Incorporation of other cases into this model, for comparison (per the iterative process of explanation building described in the Data and Methodology section)
- A study of how other countries integrated IT into their education systems and how and whether they considered both resources and intent
- A comparison to other countries that have integrated IT into education, examining what kinds of resources accompanied the commitment

Studies of this nature would enlighten both the methodology used for this study, and the developments that would further enable IT to become a viable tool for education in Africa.

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Annex 1: Human Subjects Review

Exempt Protocol Review

1. **List personnel (other than PD, Co-PD, or Faculty Sponsor) conducting study and their titles.**

   None.

2. **Describe proposed research (do NOT submit abstract from grant proposals) - include: purpose of research; procedures; type, number, and age of subjects; length of subjects' involvement; and research location. If women, children (younger than 18 years), or minorities are not included in the study population, provide a clear, compelling rationale.**

   The purpose of this research is to understand, from the policy-makers' point of view, how policies are made in the education sector in Mali and Ghana. In addition, their opinions will be solicited about how they forecast policies will be made about information technology (IT) use (i.e. computers, the Internet) in secondary schools.

   No more than six policy-makers will be interviewed via e-mail from each Mali and Ghana. These policy-makers will be from a number of different public institutions, identified by experts in the field as those interested in IT policies for education. They will be sent questions April 15(assuming this application is approved by then), and invited to dialogue via e-mail with any questions or concerns they have with the content or process. May 1, a follow-up e-mail will be sent, and the report will be distributed to them once approved by the School of Education (August).

3. **Describe procedures for subject recruitment - include: announcements, fliers, etc., if applicable.**

   E-mail messages will be sent individually to each prospective participant asking if they would like to participate in the interview, explaining why I think their perspective would be valuable and who suggested that they would be a good resource(if it's someone I don't know).

4. State who will obtain consent and how consent will be obtained (by mail, in person, etc.). Provide consent form(s)/script(s) on pages separate from answers and in English even though you may be translating them. Drafts are unacceptable. If signed consent will not be obtained, include rationale for a partial or full waiver of consent. If consent(s) will be translated, describe how you will ensure accuracy of translation (back-translation preferred). If you will be using prisoners as

subjects, contact the Panel Office for information about special consent procedures. For Bing Nursery studies, submit posted study description.

In the email requesting participants' participation in the interviews, I will request consent via email before sending my questions. The interaction with policy-makers in Mali will be conducted in French. This email requesting participation and consent will be back-translated. This is important for the consistency of the study as well, as the replies in English and French will be discussed and compared.

The following text will be included in those messages,

Risks and Benefits
There are no foreseeable risks in participating in this study. Your statements will not be connected to your name, only to the country you represent. I hope that you will enjoy the interviews, and that they will give you a chance to reflect on the policies surrounding the use of information technology in education. You will not be paid for participating in this study.

Time involvement
We will likely have several email interactions over the course of the next two months. The entire process should take you no more than 4 total hours.

Your rights
If you agree to participate in this study, please understand that your participation is voluntary and that you have the right to withdraw your consent or discontinue your participation at any time. You have the right to refuse to answer particular questions.

5. **Provide copies of all questionnaires or interview questions for each subject population (drafts/samples acceptable).**

To ensure confidentiality, I will separate the answers I receive from the names of the participants. I will categorize answers by country.

Draft questions:

Please briefly describe the process in which changes are made in country-wide education policies in Mali/Ghana (I will specify in the introductory text that I'm interested in the government's process). Who is involved (please list position names)? How long does it take? Who is tasked with implementation (again, position names, please)?

Are there any recent or ongoing changes to the education policy process?

How do you envision policy/ies being made for including information technology

in secondary schools? Who would be involved (please list position names)? How long would it take? Who would be responsible for implementing the policy/ies (again, position names, please)?

Do you feel that the policy-making process and implementation will enable Mali/Ghana to take advantage of information technology to benefit the country?

6. **State if audio/video taping will be used and if it could increase potential risk. If so, provide rationale for taping and describe confidentiality procedures. Describe what will become of tapes after use, e.g., shown at scientific meetings, erased. Describe the final disposition of tapes.**

   Question Not Applicable

7. **Provide letter of approval from school principal or official, when available, for research conducted in schools.**

   Question Not Applicable

8. **Provide letter of approval from Tribal Council, when available, for research conducted on Indian Reservations.**

   Question Not Applicable

Overseas Research

A. **Indicate subjects' literacy.**

   All subjects in Ghana are literate in English. All subjects in Mali are literate in French.

B. **What special risks to subjects may arise from the political and social condition of the nation in which research is being conducted?**

   No special risks arise from the political and social conditions in Mali or Ghana. Both countries are actively and officially promoting the use and expansion of the Internet. And, as I will not be using the names of the participants in my study, there is little chance that they will be able to be identified through the information submitted. In addition, the intent of the study (monograph for Stanford University School of Education, will be kept on file and possibly circulated within the school

in following years) will be specified in the email requesting their participation, which will enable them to guage their answers accordingly.

C. **In the case of all student overseas research - Describe qualifications/preparations that enable you to estimate and minimize risks to subjects (see B).**

Prior to coming to Stanford University, I worked as a contractor for the Academy for Educational Development on a USAID (US Agency for International Development) project to help 21 African countries connect to and use the Internet. During those four years, I became familiar with the policy arena surrounding Internet and information and education issues, and the players in that arena.

Annex 2: Survey Questions
English and French

The Process of Making Education Policy for Information Technology: The Cases of Mali and Ghana

Introduction: The purpose of this research study is to understand, from the policy-makers' point of view, how policies are made in the education sector in Mali and Ghana. In addition, your opinions will be solicited about how you forecast policies will be made about information technology (IT) use (i.e. computers, the Internet) in secondary schools. For this purpose, I will interview you via email over the course of the next several months."

Risks and Benefits: There are no foreseeable risks in participating in this research study. Your statements will not be connected to your name, only to the country you represent. I hope that you will enjoy the interviews, and that they will give you a chance to reflect on the policies surrounding the use of information technology in education. You will not be paid for participating in this study.

Time involvement: We will likely have several email interactions over the course of the next two months. The entire process should take you no more than 4 total hours.

Your rights: If you agree to participate in this study, please understand that your participation is voluntary and that you have the right to withdraw your consent or discontinue your participation at any time. You have the right to refuse to answer particular questions. If you have any questions, please do not hesitate to contact me via email (zbreslar@compsuerve.com) or telephone (USA 650 497 1434).

Protocol Approval Date: 03/31/00.

Survey Questions

Please briefly describe the process in which changes are made in country-wide education policies in Ghana per your experiences. Who is involved? How long does it take? Who is tasked with implementation? Do you feel that it is a successful process?

Are there any recent or ongoing changes to the education policy process that you know of?

How do you envision policy/ies being made for including information technology in secondary schools? Who would be involved? How long would it take? Who do you think should be responsible for implementing these policy/ies?

Do you feel that the policy-making process and implementation is important for Ghana to take advantage of information technology to benefit the country? Please explain.

Please briefly describe your role in this process of creating policy for IT in education.

L'Intégration de l'Informatique dans les Politiques d'Education :
Etudes de Cas de Mali et Ghana

Introduction : L'objectif de cette étude de recherche est de comprendre, du point de vue des responsables politiques, comment les politiques sont mises en oeuvre dans le secteur de l'éducation au Mali et au Ghana. En plus, on sollicitera vos opinions de comment vous mettriez en oeuvre des politiques de l'informatique (IT)-par exemple, les ordinateurs, l'Internet-dans les écoles secondaires. A ce but, je vous poserai des questions via courier électronique dans le courant des prochains mois.

Les risques et les avantages : Il n'y a aucun risque prévisible si vous participez à cette étude de recherche. On n'associera pas vos commentaires à votre nom, mais uniquement au pays que vous représentez. J'espère que les interviews vous plairont et vous fourniront l'occasion de réfléchir aux politiques qui concernent l'emploi de l'informatique dans le secteur de l'éducation. Il n'y aura pas de récompense financière pour la participation à cette étude.

Engagement de temps : Nous aurons probablement plusieurs interactions via email dans le courant des deux mois à venir. Il ne vous faudra pas plus de 4 heures maximum pour répondre aux questions.

Vos droits : Si vous consentez à participer à cette étude, on vous assure que la participation est facultative and que vous êtes toujours libre à retirer votre consentement ou à terminer votre participation à l'étude à n'importe quel moment. Vous êtes également libre à refuser de répondre à des questions particulières. Si vous avez des questions, n'hésitez pas à me contacter via email (zbreslar@compuserve.com) ou via téléphone (USA +1 650 497 1434).

Date d'autorisation du protocole : 31/03/2000.

Questions

Veuillez décrire-d'après vos propres expériences-le processus qui permet les changements dans les politiques d'éducation à travers tout le pays au Mali/Ghana. Qui sont les principaux acteurs ? Combien de temps faut-il ? Qui s'occupe de la mise en oeuvre ? Croyez-vous que le processus réussit à ses objectifs ?

Existe-il des changements récents ou en cours au processus des politiques de l'éducation ?

Comment envisagez-vous la mise en oeuvre de politique(s) afin d'inclure l'informatique dans les écoles secondaires ? Qui seraient les principaux acteurs ? Combien de temps faudrait-il ? A votre avis, qui seraient chargés de la mise en oeuvre de ces politiques ?

Croyez-vous que le processus et la mise en oeuvre des politiques soient importants au Mali/Ghana pour bien profiter de l'informatique dans le pays ? Veuillez expliquer.

SVP decrivez votre role dans ce processus de discussion/creation des politiques d'informatique dans le cadre d'education.

Annex 3: Findings Tables 4-8

Conditions for Successful IT Integration	Indicators	Evidence: Mali	Evidence: Ghana
Awareness	Awareness of IT in Education	Discourse: Konaré's speeches, Bamako 2000 conference sponsorship. Survey respondents' statements. Wide range of actors involved in current IT activities.	Discourse: Rawlings' endorsement. Survey respondents' statements. Wide range of actors involved in current IT activities.
	Mechanisms for Promoting Awareness of IT in Education	Publicity surrounding current IT activities. Organizations/activities building IT awareness and skills among students, teachers: Pathfinder Foundation, Internet Society. POSSIBLE: Survey respondents' opinion that IT awareness among decision-makers is imperative.	Publicity surrounding current IT activities. Organizations/activities building IT awareness and skills among students, teachers: PIE, GHACLAD, SRCs, GLOBE. POSSIBLE: Survey respondents looking to involve private sector in supporting IT in education.
	Structure Conducive to Future Awareness Building of IT in Education	Participatory nature of policy-making: 1991 National Debate and Conference on Education, creation of PRODEC. Support and autonomy for all levels of administration, through decentralization (PRODEC). PRODEC's communication strategy promoting two-way interaction through the entire system, targeting at all partners. Internet infrastructure available countrywide, privatizing telecommunications.	Participatory nature of Anglophone system: consistent stakeholder participation, National Education Forum November 1999. MOE implementation structure through GES extends to district level. SPAM, MOE communication with communities. Vision 2020 promises improved efficiency of MOE management. Privatized telecommunications promoting expansion of infrastructure, already countrywide access to Internet.

Table 4. Awareness: Evidence in Mali and Ghana.

Conditions for Successful IT Integration	Indicators	Evidence: Mali	Evidence: Ghana
Access	Access to IT *Policies with financial allocations* *Hardware and software* *Technical assistance* *Phone line/Internet connection* *Recurring costs* *Adequate space* *Actual facilities and programs*	No policies for IT in education; survey respondents think that the policy process will take time. Hardware and software available and affordable to very few. Phone/Internet access available and affordable to very few, especially in rural areas. Access to Internet outside of Bamako, and lower line cost for Internet. Inadequate school space; PRODEC plans to expand physical infrastructure. University of Mali installing Internet connectivity. MOE getting Internet access from the university for all levels of administration. Public access centers exist and are accessible to students. Activities and programs that provide access to IT: Internet Society, GLOBE, Pathfinder Foundation, MOE projects with secondary schools.	Vision 2020 promotes building technical skills. No IT/education policy yet; some survey respondents think that the policy process will take time. MOE approved distance education programs in 1996 to expand access to education (active?). IT curriculum in place. Hardware and software available and affordable to very few. Technical assistance limited, limited training available in-country. Phone/Internet access available and affordable to very few, especially in rural areas—though expanding. Access to Internet throughout country; free subscriptions for schools provided by NCS. University connectivity and Internet use, and distance education programs. Public access centers exist and are accessible to students. Activities and programs that provide access to IT: WorLD, PIE, SRCs, GHACLAD, GLOBE, individual school projects.

Conditions for Successful IT Integration	Indicators	Evidence: Mali	Evidence: Ghana
	Access to Education	Low enrollment, large class sizes, low retention rates, Teacher shortage; PRODEC promises access and improved quality. MOE encouraging communities to build schools—based on the Nouvelles Écoles Fondamentales (NEF); continued by PRODEC to encourage autonomy and provide support.	Low enrollment, large class sizes, low retention rate; Vision 2020 promises education for all. Vision 2020 promises expansion of higher education.

Table 5. Access: Evidence in Mali and Ghana.

Conditions for Successful IT Integration	Indicators	Evidence: Mali	Evidence: Ghana
Applicability	Applicability of IT to Education *Reason to use* *Planning for use* *Actual use*	IT as an ASPECT of education Secondary professional education: computer for office use. Future university connectivity and use. No IT curriculum. IT activities in education. POSSIBLE: Internet can provide info/current info to compensate for lack of materials.	IT as a MEDIUM for education Vision 2020 promises education and training for skill development, with an emphasis on science, technology, and creativity. University IT use and programs, distance education programs. Adoption of the West Africa Examination Council's curriculum for teaching IT applications. IT activities in education. FCUBE computer training for MOE management. POSSIBLE: Internet can provide info/current info to compensate for lack of materials.
	Mechanisms for Applying IT to Education *Teacher training* *Time for teachers to explore, apply* *Time in class to use*	Not enough teachers. PRODEC: will improve in-service and pre-service teacher training. Nothing mentioned about IT training.	Teacher absenteeism, low morale. Teachers are not inclined to work extra hours. In-service teacher training has increased, being delivered both at the district and school levels. Nothing mentioned about IT training. Insufficient class time already a problem.

Table 6. Applicability: Evidence in Mali and Ghana.

Conditions for Successful IT Integration	Indicators	Evidence: Mali	Evidence: Ghana
African Adaptation	Innovation to maximize and tailor IT use for African development	Education system not applicable to Malian needs. PRODEC promises to make higher education applicable to economic needs. Community control of schooling allows tailoring to their needs. Language of instruction: PRODEC continues to encourage maternal languages in primary education. Konaré's discourse encourages innovation, and developing and implementing own solutions; sponsorship of Bamako 2000 conference. Pathfinder Foundation promoting African science and innovative entrepreneurship.	Education system seemingly tailored to national needs. IT incorporated, including creativity. Though this plan is new, must wait for results to judge effects. SPAM: community management of schools. Telecommunications reforms show awareness of the need for Ghanaian ownership and meeting country's demand. Rawlings, Quaynor: need to develop human capacity to participate in global systems. Promotion of IT in education and promoting African knowledge, methods, and innovation: PIE, SRCs, and GHACLAD.

Table 7. African Adaptation: Evidence in Mali and Ghana.

Conditions for Successful IT Integration	Indicators	Evidence: Mali	Evidence: Ghana
Advocates	Individuals at all levels catalyzing IT use	Konaré's discourse. Advocates in a number of kinds of organizations. People/organizations running IT in activities in education.	Rawling's endorsement. Vision 2020. Telecom network operators aware of need for expansion. Quaynor's aspirations for growing indigenous technical skills. Advocates in a number of kinds of organizations. People/organizations running IT in activities in education.

Table 8. Advocates: Evidence in Mali and Ghana.